Unity Pro
Concept Application Converter
User's manual

December 2004

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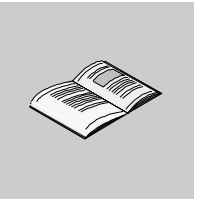
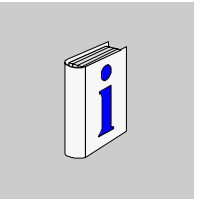


About the Book



At a Glance

Document Scope

This document describes the functionality and performance scope of the Concept Application Converter for Unity Pro.
This document is valid for Unity Pro starting from Version 2.0.2.

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Requirements and conversion

I

Introduction

Overview

This section contains requirements and information about the conversion.

What's in this Part?

This part contains the following chapters:

General Description of the Unity Pro Concept Converter

1

General description

Brief description

The Concept Converter is an integrated function in Unity Pro, which is used to convert Concept applications into Unity Pro. This means that Concept programs can also be used in Unity Pro.
Substitute objects are used in place of objects that cannot be converted, and messages are displayed in the output window to find these objects.
Descriptions of the respective procedures are provided in chapter *Conversion Procedure, p. 63*.

Note: Reconverting from Unity Pro back to Concept is not possible.

Conversion

The conversion is carried out in 4 steps:

1. **In Concept:** Export the Concept application using the Concept converter which creates an ASCII file.
2. **In Unity Pro:** Open the exported ASCII file (*.ASC) in Unity Pro.
3. **In Unity Pro:** Automatic conversion of the ASCII file into Unity Pro source file format.
4. **In Unity Pro:** Automatic import of the Unity Pro source file.

Objects, which cannot be converted

The following objects cannot be converted into Unity Pro:

- Compact and Atrium configuration
- I/O initialization (except 0)

Requirements

2

Introduction

Overview

This chapter contains the requirements for converting a Concept project into a Unity Pro project.

What's in this Chapter?

This chapter contains the following topics:

Concept Version

General

Projects from Concept versions 2.11 and 2.5 and 2.6 can be converted to Unity Pro projects.

Preconversion

If an older version of a Concept project should be converted to Unity Pro, the project must be first converted within Concept to bring it to version 2.6 status for security reasons.

Supported Hardware Platforms

General

Unity Pro supports the hardware platform Quantum.

Quantum PLC Types

The following Quantum PLC types are supported by Unity Pro (after downloading the respective EXEC file):

- 140 CPU 311 10
- 140 CPU 431 20
- 140 CPU 434 12A
- 140 CPU 531 40
- 140 CPU 534 14A
- 140 CPU 651 50
- 140 CPU 651 60
- 140 CPU 671 70

Types which no longer exist are replaced by the A type (e.g. 140 CPU 434 12 replaced by 140 CPU 434 12A). Lower PLC types are automatically adjusted to the 140 CPU 311 10.

Configuration

General

Unity Pro only supports IEC conformant programming.
Concept sections created using the LL984 programming language are converted to the LD programming language in Unity Pro in a later version.

Restrictions for old LL984 Configurations

The following points from LL984 configurations are no longer supported by Unity Pro:

Not supported by Unity Pro	Supported by Unity Pro
LL984 loadables	Concept system and IEC loadables are completely integrated.
ASCII messages	Unity Pro provides string variable instead.
User loadables	Unity Pro provides the equivalent EFBs or DFBs instead.
6x range (register in expanded memory)	The Concept converter still saves the values in data structures (but only in a later version of Unity Pro).
Mixed programmed projects (LL984 + IEC)	The LL984 contribution is converted to LD-IEC.
Data memory - write protection	Unity Pro provides write protection variables instead.

Hot Standby (HSBY)

There are the following differences for converting the Concept Hot Standby to Unity Pro:

Concept	Unity Pro
The Hot Standby system in Concept is based on the 140 CHS 111 00 module.	This module is **no** longer supported by Unity Pro.
The 140 CHS 111 00 module is purely a Hot Standby Module for **a single** slot. The power is supplied via the rack.	The CPU 671 60 module is a CPU module for **two slots** with a fixed assigned connection for data exchange. The Hot Standby system is integrated into the CPU 671 60 module.

The Concept converter replaces the CPU from Concept with the new Hot Standby CPU 671 60 and the Concept Hot Standby Module 140 CHS 111 00 is removed. All Hot Standby parameters are transferred to the Unity application.

Note: As the CPU in Concept only requires **one** slot, but the new Unity CPU requires **two**, overlaps in the rack may arise. These must be resolved manually by the user.

System

Security

The access authorizations defined in Concept are **not** converted to Unity Pro. Security is project specific in Unity Pro and does not refer to the respective installation as with Concept.

Program Execution

Program execution using Concept and Unity Pro are different. It can lead to different behavior during the first program run after a restart.
Program execution for Concept:
1. Write the outputs (program run n-1)
2. Read the inputs (program run n)
3. Program processing

Program execution for Unity Pro:
1. Read the inputs
2. Program processing
3. Write the outputs

Example:
In Concept, you have assigned a 4x register to a digital output and stopped the PLC when the value is "true". After a restart, the value remains "True" during the first program run even if you have modified the process conditions.

Specified execution order

The execution order in the function block language in Concept is determined first of all by how the FFBs are positioned. If the FFBs are then linked graphically, the execution order is determined by the data flow. After this the execution order can be changed based on the intention.
In Unity Pro after conversion it is not possible to see in what order the FFBs were positioned. Therefore, whenever the order cannot be determined unambiguously from the data flow rule alone, the order is defined by the Concept project.
The defined execution sequence is shown by means of a rectangle with the step number in the upper right-hand corner of the FFB.

Single Sweep Function

The single sweep function is no longer supported by Unity Pro.
The corresponding functionality can be realized in Unity Pro using the Debug function "Breakpoints".

EFB Download

Using Concept, all platform dependent EFBs can be placed at any time and loaded in all PLC platforms. Any errors during runtime are written to the message memory. In Unity Pro, only valid EFBs can be placed. Download to the PLC is only possible if the EFBs used are consistent with the PLC platform.

Reference Data Editor (RDE)

RDE tables created in Concept are converted to Unity Pro when they are placed in the same directory as the Concept ASCII file.

Global Variable Values

Because of different restart behaviors after a power failure, it is possible that the global variable states of two PLCs that restart differently are not the same after the first program run.

There are two different types of restart behavior:

1. All 16 bit PLCs (all Momentum, Quantum 113, 213, 424) continue executing the program at the point at which it was interrupted.
2. All 32 bit PLCs (Quantum 434, 534) start the program run at the beginning.

Unity Pro supports the 1st type of restart behavior described above.

State RAM

The Concept State RAM registers are assigned IEC conforming addresses in Unity Pro.
I/O module addresses are converted to topological addresses.
State RAM register **without** an assigned I/O module

Concept	Unity Pro
4x	%MWx
3x	%IWx
0x	%M
1x	%Ix

To describe a state RAM register **without** an assigned I/O module, a "flat" address is used. For this, the register number is added to the end of the introduction.
The address reads as follows:
`%[IM][W]Register number`
State RAM register with an assigned I/O module

Concept	Unity Pro
4x	%QW, %IW (mixed I/O)
3x	%IW
0x	%Q
1x	%I

The following information is read from the configuration to provide a sufficient topological description of a State RAM register with assigned I/O modules:
- Bus number (corresponds to drophead in Concept)
- Drop
- Rack
- Module
- Channel

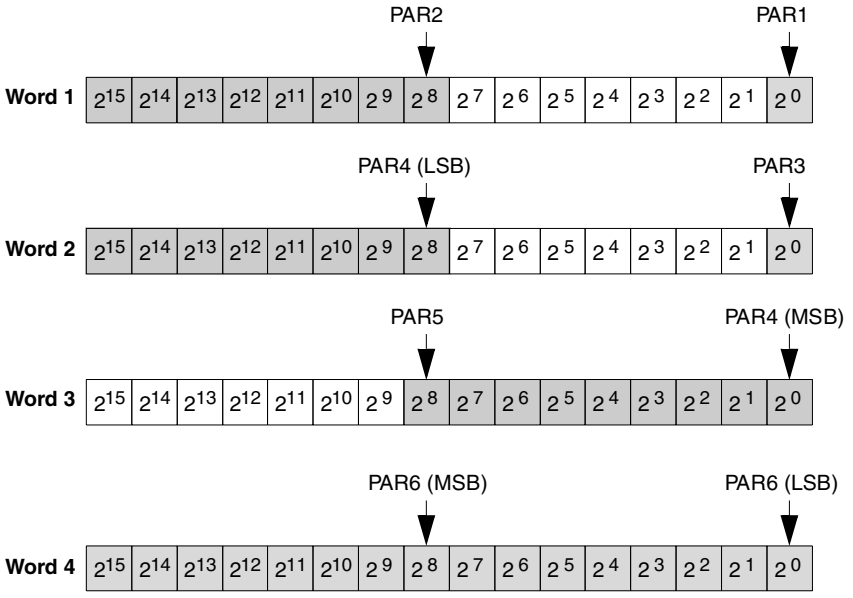
The complete address reads as follows:
`%[IQ][W]\Busnumber\Rack.Drop.Module.Channel`

State RAM assignment using derived data types

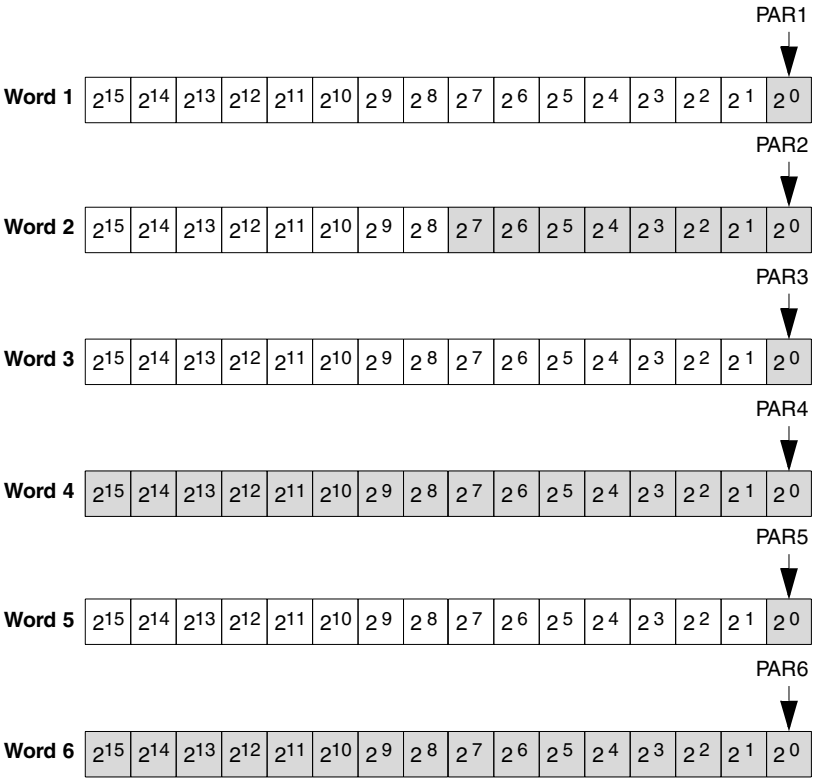
In Concept, data structure elements begin at BYTE limits.
In Unity Pro, data structure elements begin at WORD limits.
Example of a derived data type:

```
TYPE
  SKOE:
   STRUCT
   PAR1: BOOL;
   PAR2: BYTE;
   PAR3: BOOL;
   PAR4: WORD;
   PAR5: BOOL;
   PAR6: WORD;
   END_STRUCT;
END_TYPE
```

The derived data types are stored in the state RAM when using **Concept**:



The same derived data types are stored in the state RAM when using **Unity Pro**:



Timer, Date, Battery Monitoring

Timer address, date/time of day and the battery monitoring can no longer be assigned to the State RAM with Unity Pro. All required information can be accessed via the control panel.
When Concept is converted to Unity Pro, DFBs are created which can be simulated in Unity Pro without further manual modifications of these functionalities.

Note: The Concept Timer Register is 16 bits long and has an accuracy of 10 ms. The equivalent system word %SD18 in Unity Pro is 32 bits long and has an accuracy of 100 ms. If this accuracy is not sufficient, the FREERUN function from the System library can be used, which delivers accuracy of up to 1 ms.

Note: When dealing with days of the week, the value 1 corresponds to **Sunday** in Concept and **Monday** in Unity Pro.

Quantum Diagnostics Words

In Unity, the diagnostics words are specified to be a certain numbert:
- Local I/O: 16 Words
- RIO I/O: 16 Words
- DIO I/O: 16 Words

In Concept it was also possible to specify a smaller number of diagnostics words for the individual I/Os.
Keep this difference in mind, since it can cause problems.

Topological Addresses

The topological addresses are assigned so that if the hardware configuration remains the same, they occupy the same I/O connections as they were assigned in Concept.
The user sees the hardware addresses in Unity Pro that they are using, without having to carry out the intermediate step via the State RAM.

Located Variable

Located BOOL variables in Concept are converted to EBOOL variables in Unity Pro. Unity Pro provides this new BOOL variable for the detection of transitions (edges). This "Elementary BOOL type" is used for %Ix, %Qx and unlocated variables. EBOOL variables can be forced.
The EBOOL variable provides three types of information depending on the State RAM registers 0x/1x:
- Current value
- Historical value
- Force information.

Only the current value can be accessed, the other values can only be accessed via product specific functions.

Longer cycle time via EBOOL

In Unity, as opposed to Concept, the edges and force information is updated from EBOOL variables during program runtime.
For this reason on the Quantum CPU 434, CPU 534 and CPU 311 platforms, the assignment of EBOOL variables is **only half as fast** as the assignment of BOOL variables.

Note: If you need variables in the signal memory, use BOOL variables and assign them to the memory area %MW (e.g. BoolVar : BOOL AT %MW10). Otherwise use unlocated BOOL variables.

Constants

Constants in Concept are converted to write-protected variables in Unity Pro.
Unity Pro does not provide constants. Comparable functionality is achieved using write-protected variables.

0x Register

In Concept, the 0x registers are **not buffered**. They are reset to zero with every warm restart.
In Unity Pro, the 0x registers are **buffered** ("RETENTIVE", "VAR_RETAIN"), i.e. Conform to IEC.
Do not use the possibility to set the 0x register to zero on every warm restart if you use a project in Concept that you want to convert to Unity Pro.

Note: If you require non-buffered behavior, define the warm restart event with the SYSSTATE function block and explicitly copy the value 0 (zero) to the 0x register.

Quantum Remote I/O Control

In Concept, only LL984 sections can be assigned I/O stations (Drops). This is not possible in Concept projects with IEC conforming sections (FBD, LD, SFC, IL, ST). Unity Pro offers this option, in which a logic is recreated in accordance with LL984. This logic must be entered manually, however.
Example of a section processing order in Unity Pro:

```
Section n-2
Section n-1
RIO call (u,v,w)
Section n
Section n+1
RIO call (u+1,w,x)
Section n+2
RIO call (u+2,x,y)
```

RIO (x,y,z) is the explicit I/O call here:

- Write the outputs to the I/O station x.
- Wait at the inputs of the I/O station y.
- Prepare the inputs of the I/O station z.

Note: Take these new settings into consideration when structuring your project.

Setting Variables Cyclically

Unlocated variables **cannot** be set cyclically in Unity Pro. (It is possible in Concept). If you need to set variables cyclically in your project, you should use located variables.
0x/1x registers (EBOOL) can be forced.
3x/4x registers can be set cyclically (only numerical values).

EFBs

General

The following options are available for converting Concept EFBs to Unity Pro:

- The EFBs are also supported in Unity Pro; They are mapped on a one to one basis.
- The EFBs are **no** longer supported by Unity Pro.
  Instead of EFBs appropriate DFBs are placed in the application. The functionality remains unaffected by this.
- The EFBs are **no** longer supported by Unity Pro.
  Instead of EFBs, DFBs with no programmatic content are placed in the application. These DFBs contain all the Concept parameters.
  An error message is displayed that says that the programmatic content for these DFBs must still be created.

DIAGNO library

When converting Concept to Unity Pro for all DIAGNO blocks the station parameter is omitted.
The following EFBs from the DIAGNO library in Concept are converted to empty DFB's in Unity Pro.

- ACT_DIA
- XACT_DIA
- ERR2HMI
- ERRMSG

Note: These DFBs, created in Unity Pro have all the Concept parameters but no programmatic content. An error message is displayed that says that the programmatic content for these DFBs must still be created.

When creating programs in Unity Pro instead of the ACT_DIA and XACT_DIA EFBs use the XACT EFB.
For all DIAGNO blocks which can be extended in Concept (D_PRE, D_GRP ...), the extensible inputs (IN1 ... INx) are **gathered together in one**input. This is implemented using a nested logic AND link. In the FBD language the AND block is positioned at the same location as the DIAGNO block by the converter. This overlap must be resolved manually by the user.

SYSTEM library

The SKP_RST_SCT_FALSE and LOOPBACK EFBs cannot be used in Unity Pro.

FUZZY library

The FUZZY library is no longer supported by Unity Pro.

HANDTABL library

The HANDTABL library is no longer supported by Unity Pro.

EXPERTS library

The following Concept EFBs are converted to DFBs in Unity Pro:

- ERT_TIME
- SIMTSX22
- EFBs from the EX family
- EFBs from the MVB family
- EFBs from the ULEX family

Note: These DFBs created in Unity Pro have all the Concept parameters but no programmatic content. An error message is displayed that says that the programmatic content for these DFBs must still be created.

The data structures DPM_TIME and ERT_10_TTAG from the time stamp module 140 ERT 854 10 have been changed. The MS element was broken up into MS_LSB and MS_MSB. For more information about this, see *State RAM assignment using derived data types, p. 20*.
Outputs which describe data structures must be assigned event variables using the (=>) assignment operator within the parameter brackets in the ST and IL languages. This happens automatically during conversion (from Unity 2.0 onwards). The functionality remains the same but the section of the program looks a little different.

Converted EFBs

During conversion, Unity Pro standardizes the EFB offer by grouping redundant EFBs. The respective EFBs are automatically converted and the project adjusted accordingly.

Renamed EFBs

The following diagnostics EFBs are renamed when converting Concept to Unity Pro:

Concept	Unity Pro
XACT	D_ACT
XREA_DIA	D_REA
XLOCK	D_LOCK
XGRP_DIA	D_GRP
XDYN_DIA	D_DYN
XPRE_DIA	D_PRE

The Quantum configuration EFB for the Backplane Expander 140 XBE 100 00 is renamed when converting Concept to Unity Pro:

Concept	Unity Pro
XBP	XBE

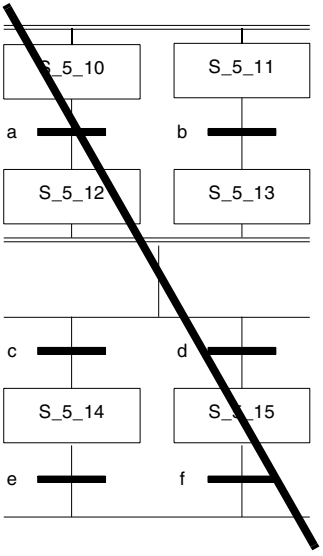
Programming Language SFC

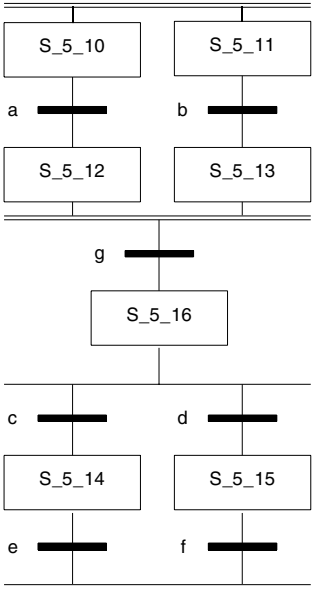
General

For some programming languages there are restrictions to observe when converting a project from Concept to Unity Pro.

Parallel/ Alternative Sequence

A parallel branch may not be directly followed by an alternative branch.
This type of sequence is not permitted according to IEC 1131.
Unity Pro does **not** support this type of sequence, although it is possible in Concept.
The converter transfers this type of project to Unity Pro, but manual modifications are subsequently required.
This problem can be solved by inserting an dummy step between the branches.





Programming Language LD

General

For some programming languages there are restrictions to observe when converting a project from Concept to Unity Pro.

Converting the graph

When converting a Concept project to Unity Pro, the ladder diagram LD graph is also converted, which can lead to a restructuring of the graph.
Concept Application Converter (Unity Pro 2.0.2) was modified. For behaviour changes please refer to FAQs.

Programming Language ST/IL

General

For some programming languages there are restrictions to observe when converting a project from Concept to Unity Pro.

Generic EFBs

Only call generic EFBs instances once.
Using Concept 2.2, assign the outputs directly after the EFB call of a variable.

Syntax with Concept 2.5

Only use the new syntax for Concept 2.5 (from Unity V2.0 onwards it is automatically converted).
Syntax with Concept 2.5:

```
GenEFB(in1:=x1, in2:=x2, out1=>x3, out2=>X4;
```

in1, in2, out1 and out2 are type ANY.

Generic EFBs in Concept

List of generic EFBs in Concept:

- COMM library
  - XXMIT
- CONT_CTL library
  - DEADTIME
- EXTENDED library
  - HYST
  - INDLIM
  - LIMD
  - SAH
- LIB984 library
  - FIFO
  - LIFO
  - R2T
  - SRCH
  - T2T
  - GET_3X
  - GET_4X
  - PUT_4X

Declaring EFBs

The declaration of EFBs in Unity Pro is found in the variables editor and no longer in the ST/IL sections as with Concept.
EFBs declared this way are no longer limited to only one section.

Programming Language LL984

General

For some programming languages there are restrictions to observe when converting a project from Concept to Unity Pro.

LL984 is no longer supported by Unity Pro

Unity Pro only supports IEC conforming programming. The programming languages LL984 and LL984 specific configurations are not supported by Unity Pro.
Concept sections, created using the LL984 programming language, are converted to the LD programming language in Unity Soft (from Unity Pro V2.0 onwards).
See also *Restrictions for old LL984 Configurations, p. 15*.

Programming Language FBD

General

For some programming languages there are restrictions to observe when converting a project from Concept to Unity Pro.

Macros

When converting a Concept project to Unity Pro, sections created using macros are also converted.
These sections can also be manually copied and modified.

Language differences

3

Introduction

Overview

This chapter contains information about language differences.

What's in this Chapter?

This chapter contains the following topics:

Functions Not Present in Unity

DFB wrapper

Functions from Concept that are not present in Unity get a DFB wrapper if they are called in ST sections (e.g., `WORD_AS_UDINT`). For example:

```
WAUD(* UDINT *) := WORD_AS_UDINT (LOW := WAUL, (* WORD *) HIGH
:= WAUH(* WORD *));
```

. . . looks like this after conversion:

```
WAUD(* UDINT *) := FBI_ST1_75_33 (LOW := WAUL, (* WORD *)HIGH
:= WAUH(* WORD *));
```

Manual correction

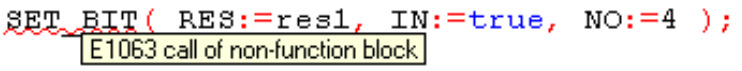
`FBI_ST1_75_33` is the instance name of the provided DFB wrapper. However, the call is still invalid for the analyzer because the converter cannot yet do multi-object syntax corrections in ST. (Will be present in V2.0).
You must correct this manually to:

```
FBI_ST1_75_33 (LOW := WAUL, (* WORD *) HIGH := WAUH(* WORD *),
OUT => WAUD);
```

EFB replaced by function

Error message

Some standard Concept EFBs are implemented in Unity as functions.
If the converted application contains (in an ST or IL section) a call to such an EFB, an error will be generated while analyzing the project.
The following figure is a sample explanation of the SET_BIT function block:



Manual correction

The `SET_BIT` function officially replaces `SET_BITX`, which is not implemented in UNITY. `SET_BIT` now is a function, and therefore the instance has been eliminated and the function name itself has been inserted instead.
However, an additional manual correction of the call is required. The converter does not do multi-object syntax corrections in ST or IL (will be present in V2.0).
Since this is a function call, the result must appear on the left side of a function assignment:

```
res1 := SET_BIT(IN := true, NO := 4);
```

INOUT parameters

Manual Correction

INOUT parameter syntax in ST (and IL) must be corrected manually. Examples are shown:

```
Ascii_FIFO_OUT (Pile := AscFifo_Mess); .....

AscFifo_Out := Ascii_FIFO_OUT.DataOut;
```

. . . is manually corrected to:

```
Ascii_FIFO_OUT (Pile := AscFifo_Mess, DataOut => AscFifo_Out);
```

Output Parameters

INOUT parameters in ST sections that were output parameters in Concept (e.g., DataOut of FIFO) must be moved manually in ST and IL to the parameters inside parentheses associated with the call.
If INOUT parameters that were outputs only in Concept are connected only to a link at the output side, they must get a manually declared variable at the input side as well. The link must be deleted if it is not connected to another IN/OUT variable. Targets of the deleted link must be assigned to the manually declared variable. This is done automatically in V2.0.

Change of Variable Type

The converter changes the type of direct variables at INOUT parameters of communication blocks to ARRAY[0..0] OF WORD.
This must be corrected manually to correspond to the size of the array.

Parameter type changed

Change

The parameter type has been changed from type WORD to an array of located words.

Explanation

Unity Comm EFBs no longer accept a single WORD address for the communication field because more than one WORD is written. So the converter introduces an artificial array (shown in the conversion report) that can be reached from the project tree through the appropriate hyperlink:

```
"For var WORD1 type ARRAY[0..0] OF WORD generated"
```

The array has a single word size because the converter can not determine its size. The user, therefore, needs to manually configure the correct array size.

ANY_ARRAY_WORD parameters

Error Message

For EF/EFB pins that have the type WORD in Concept and have been changed to ANY_ARRAY_WORD in Unity, "Cannot import variables" will be the reported type. Such pins usually have a single register address as a formal parameter in Concept, but it is actually used to point to an array of words for which the size has not been explicitly declared.

Change of Parameter Type

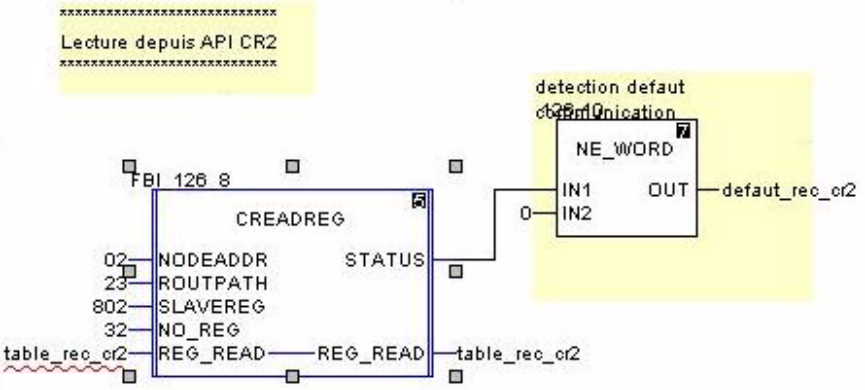
In Unity, an array of words has to be declared for this purpose. This is why the converter changes the type to ARRAY[0..0] OF WORD.
However, the converter cannot determine the required size because a size declaration is absent in the Concept application. Therefore, the converter defines one data element, [0..0], as a replacement for the original variable.
It is up to the user to replace this default range of one element with the number of elements required by the application.

Redefine Back to a One-Dimensional WORD Array

In case the application defined data structures that are mapped to registers that describe the data to be worked with, significant work to redefine this back to a one-dimensional WORD array is required. However, this is necessary for Unity V1.0, for example:

```
{Echanges_CR2 : [MAST]} : (r: 42, c: 7) E1092 data types do
not match ('CREADREG.REG_READ:ANY_ARRAY_WORD'<-
>'table_rec_cr2:peer_Table')
```

Example:



The Unity converter V2.0 will change these EFB parameter types to ANY, avoiding this problem.

Unique Naming required

Unique name

In Concept applications, section names can have the same name as a DDT. That is not the case in Unity.
The converter checks section names to see if they are redundant of DDT names. If so, the converter appends "_Sect" to the section name.

Incomplete LD Generation

LD Generation Not Done Completely

In some cases, LD generation cannot be completed. This can happen when the algorithm allows an object that requires the same position as an existing object. In these cases, the pre-existing object is overwritten.
Messages are issued to make you aware of this:

```
{SAFETY_INTERLOCKS_PLC3 : [MAST]} :
(r: 8, c: 3) E1189 converter error: 'Overwrite happened when
generating LD network - see report'

{SAFETY_INTERLOCKS_PLC3 : [MAST]} : (r: 8, c: 3) E1002 syntax
error
```

Details in Conversion Report

In the conversion report, which may be opened after being imported through the hyperlink in the project tree, some additional detail about the message is given:

```
09:29:05.953 > Error: LD Object PTFDTP1_ENABLED with type coil
overwritten
```

The user should compare the conversion result to a printout of the original section and correct the converted section accordingly.

LD Execution Order Changed

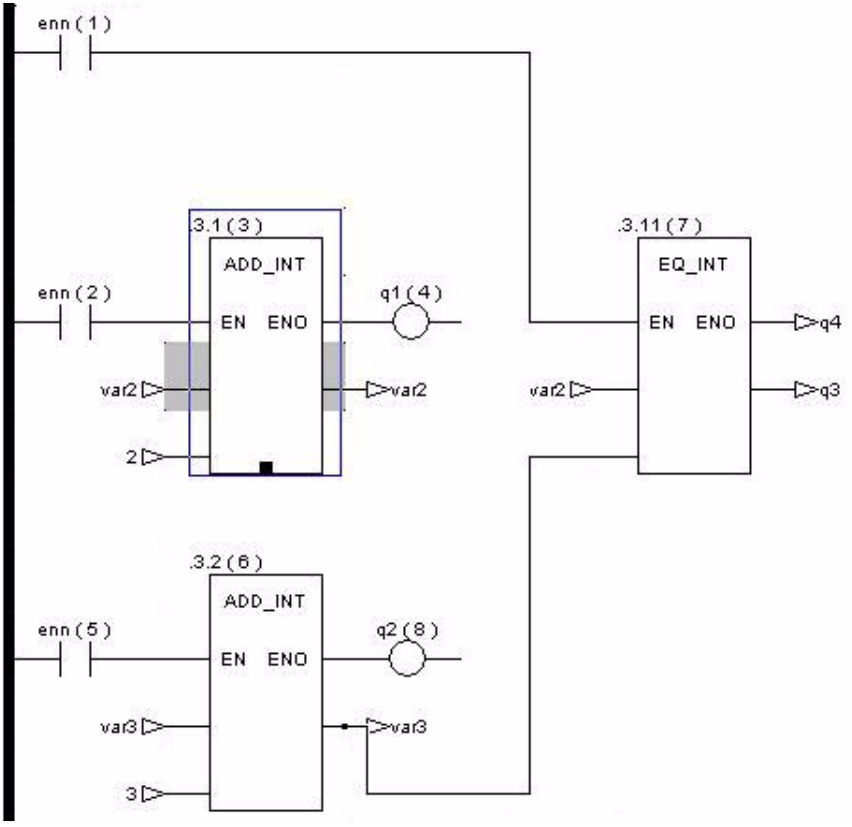
Different Execution Orders

Note: Unity's LD execution order can differ from Concept's. In Unity, one LD network can be completed before the next is started.

The converter follows the Concept execution order in graphical positioning, making the original order visible to the user. However, since Unity calculates the order anew (without the possibility of forcing it from the converter), there can be execution order discrepancies.

Concept

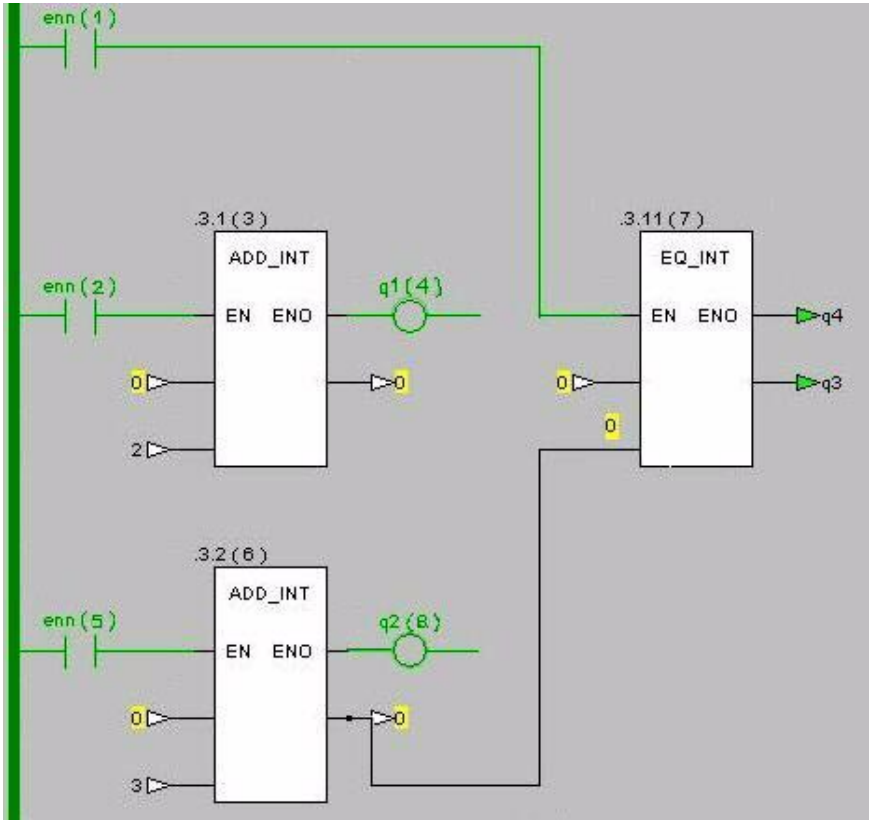
When analyzing in Concept, the execution order is calculated. The result is shown in parentheses after the instance names in this image.
The selected block is executed in the middle of the other network, even though it has no direct connection to it. Concept calculates the execution order from the block position.
This is the original section as it appears in Concept:



The used variables are initialized in a way that the result of the comparator `EQ_INT` becomes "true" after execution of the first cycle in Concept:

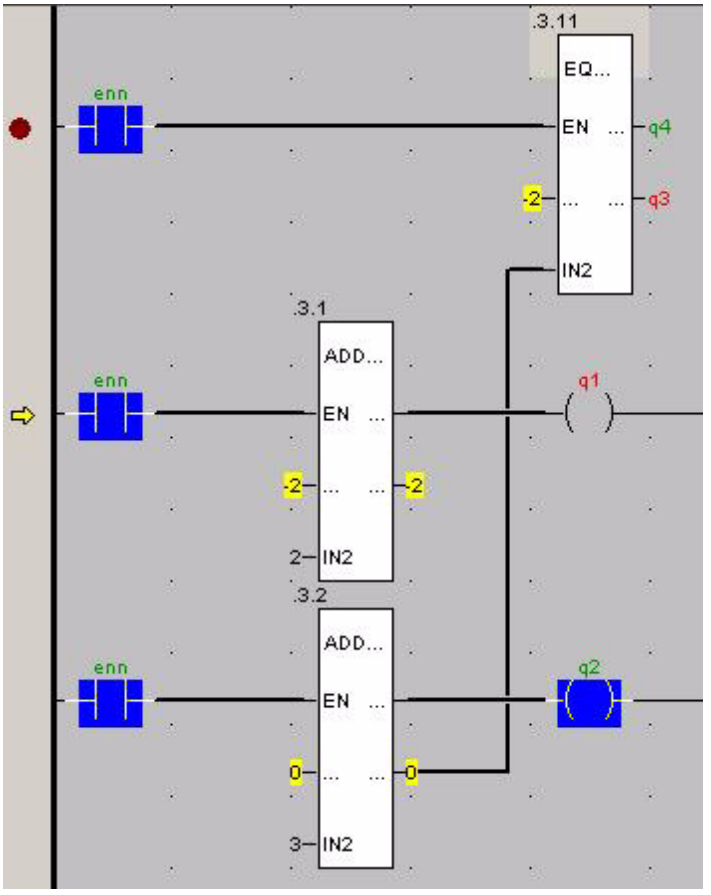
var2	INT	-2
var3	INT	-3

Testing execution in single cycle mode in Concept shows the expected result. The comparator result becomes "true" after the first cycle:



Unity

The converted network reflects the Concept execution order in the graphical position of the blocks:



The image also shows the execution status stopped at a breakpoint in the first cycle. The comparator `EQ_INT` is already executed and will not deliver a "true" result because the first `ADD_INT` integrator block is executed **after** it.

Solution

Replace the connection via a variable by a link to achieve the same result as in Concept.

Constants

Losing the Read-Only Behavior

Constants are not accepted as private DFB variables. Therefore, they are converted to initialized variables in DFBs, in this way losing the read-only behavior.

Indices in ST

Resolution

Concept Application Converter (Unity Pro 2.0.2) was modified. For behaviour changes please refer to FAQs.

Calculate with `TIME` and `REAL`

Manual Correction

When `TIME` and `REAL` variables are multiplied in ST, `REAL_TO_DINT` must be inserted into the REAL variable manually.

`WORD` Assignments to `BOOL` Arrays

Manual Correction

Assignments of HEX WORDS to complete Bool arrays sent to Word registers are possible in Concept, but not in Unity. A manual correction must be done, for example:

```
('AR2_BOOL[0]:BOOL'<->'16#0100:DINT')

('AR2_BYTE[0]:BYTE'<->'16#55AA:DINT')

('AR2_BYTE[0]:BYTE'<->'16#AA55:DINT')
```

Solution

The ST code must be changed to single-component assignments.
The hex word must be split into single bits:

```
AR2_BOOL[17] := true;
```

Topological Address Overlapping

Same Topological Address

In Unity, you are warned (during application analysis) if the same topological address is assigned to multiple variables.

Structure Alignment Changed

DPM_Time Structure

Unity uses a 2-byte alignment for structures in contrast to Concept (1-Byte) to speed up the access to structure components. This affects system structures mapped to StateRam, because the same structures in Unity can be bigger including some byte gaps.
The concerned structure is `DPM_Time`, which has been redefined for Unity to re-map to the correct hardware addresses.
Concept's DPM_Time definition:

```
sync: BOOL
ms:   WORD
...
```

Unity's DPM_Time definition:

```
sync:   BOOL
ms_lsb: BYTE
ms_msb: BYTE
...
```

Manual Correction

If an application that includes the `DPM_time` structure is converted, the analyze/build process will fail for the redefined structure components (in the above example, `ms_lsb`, `ms_msb`).
The user has to manually change the usage of these structure components in the application accordingly.

Undefined Output on Disabled EFs

Outputs of EFs Not Kept

In case the EN switches from `TRUE` to `FALSE`, the outputs of EFs from the previous cycle are not kept in Unity. This reduces the memory consumption in the PLC. This is different from EFBs, which keep their value from the previous cycle. Concept uses static links to latch the value from the previous cycle.

Execution Behavior Differs Significantly

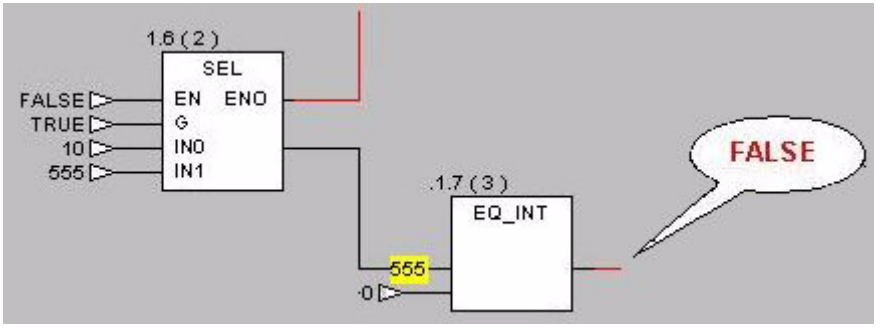
If a Concept application relies on the outputs of EFs to keep their old values, the execution behavior in UNITY will differ significantly.

Manual Correction

The application has to be changed manually.
Links from outputs, which are assumed to keep their value, need to be replaced by variables. If the `EN` of an EF is set to false, the EF is not executed and a connected variable is not touched.

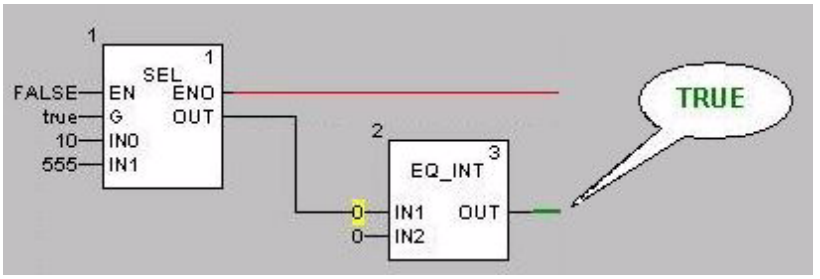
Concept

The output of the disabled `SEL` EF is kept and used as input for the `EQ_INT` function block:



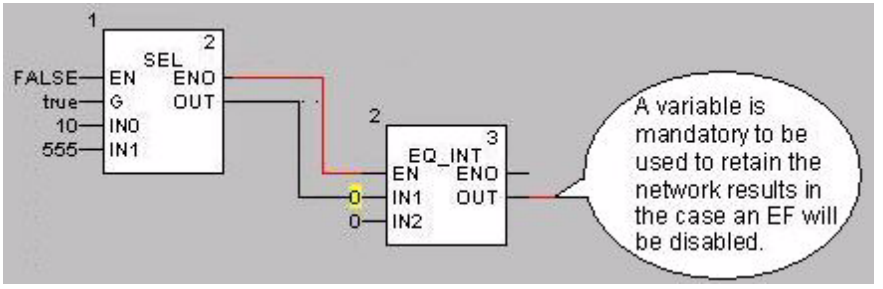
Unity

The output of the disabled SEL EF gets an undefined value, in this case 0. Therefore the output of EQ_INT function block has become true:



Solution

If the EN of the SEL is set to false, the ENO of the EQ_INT is also set to false, but the connected output variable keeps its value from the previous cycle:



Note: The use of a variable is mandatory to retain network results in case an EF becomes disabled.

SFC Section Retains its State When Performing an Online Modification

Online Modifications Without Resetting

In Unity it is possible to do online modifications of an SFC chart without resetting it. The SFC chart retains its state and will continue the execution.

Note: In Concept, the online modification of an SFC chart usually results in the resetting of the chart.

Weekday Numbering

Different Numbering

In Unity the numbering of weekdays is different than Concept:

Number	Unity	Concept
1	Monday	Sunday
7	Sunday	Saturday

SET_TOD / GET_TOD

Function blocks: `SET_TOD` and `GET_TOD` will be converted to Unity as DFBs, which work in both directions.
Because `SET_TOD` expects a "Concept" numbered weekday and translates it as a Unity coded value. Also the `GET_TOD` reads Unity value and returns to User the Concept value.

System Word %SW49

Note: We do not recommend that you mix `GET_TOD` and `SET_TOD` programming with the use of system words (e.g. `%SW49`) in the same application.

System Timer

Concept

Concept's system timer was located on a user-defined register word (16-bit) and incremented at 10 ms.

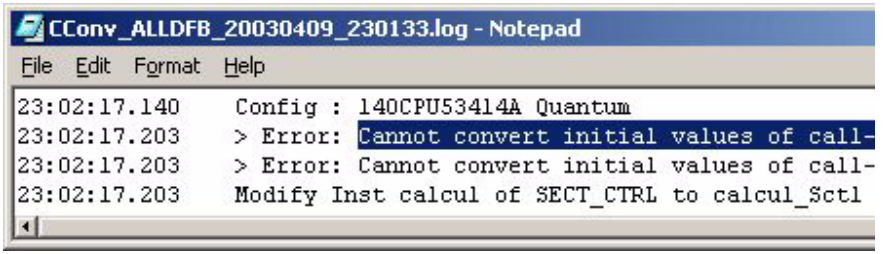
Unity

Unity provides an incremental timer with 100 ms updating (`%SD18`).
A 10 ms timer can be logically created using the `FREERUN` function (sec timer).

Initial Values

Definition of Initial Values

Concept allows the initial values on DFB pins of a structured array to be defined. Unity reserves this option for output pins.
The converter reflects this with the following error message in the conversion log:




```
Error: Cannot convert initial values of call-by-reference data
(pin Add_PV.in1)
```

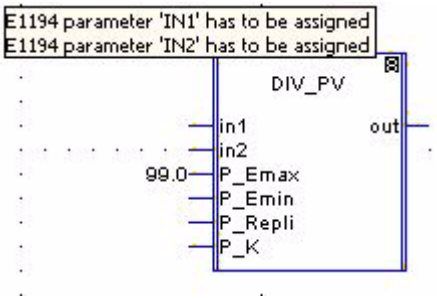
Pins to be Connected

At the same time, Unity enforces pins of array type and input pins of structured type to be connected, which in this case leads to analysis errors:

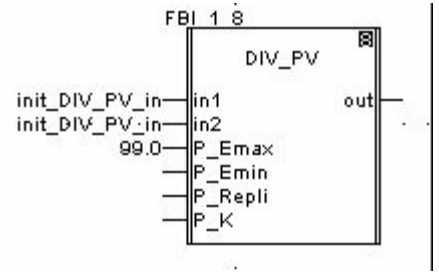
```
{ALL:[MAST]}:   (r:26, c:68) E1194 oarameter ´IN2´has to be
assigned
{ALL:[MAST]}:   (r:26, c:68) E1194 oarameter ´IN1´has to be
assigned
```

Solution

To solve this problem, create a variable of the pin's type and initialize it with the original values.
Connect this constant to the appropriate pin of each DFB instance.
Example



Solution: Add initialized variable.



Macros

Macros Replaced by Dummy DFBs

Macros (name starting with @) are refused by the converter because Unity does not implement macros. However, if you try to import an application containing macros, they will be replaced by dummy DFBs (as indicated by the '~' character in the application name).
While analyzing the project, you will get error messages regarding these dummy DFBs. To correct these errors, simply remove all of the DFBs that were created as a replacements for macros.

AXx, EPARx Parameters

AXx and EPARx parameters in Concept's extensible motion blocks are automatically invoked with the newly required array instead of with Unity's formerly present extensible pins. Constants present at the Concept pins are also placed as initialization values to such arrays. However, variables and links must be attached manually with move blocks to these arrays.

Possible application behavior change

4

Introduction

Overview

This chapter contains information about possible application behavior change, when migrating from Concept to Unity Pro.

What's in this Chapter?

This chapter contains the following topics:

General

Concept

In Concept all parameters of EFBs (Elementary Function Blocks) were generally handled by reference.
Because of this it was possible without any problem to modify a variable connected to an output of a function block from another location inside the application or by an HMI tool, when the function block was NOT writing the output.
This behavior was used to realize for example the manual mode of closed-loop-control function blocks.

Changes in Unity

Because of IEC compliance the parameter handling was changed from Concept to Unity and the way of multi-assignment described above doesn't work any longer.

Behavior may change

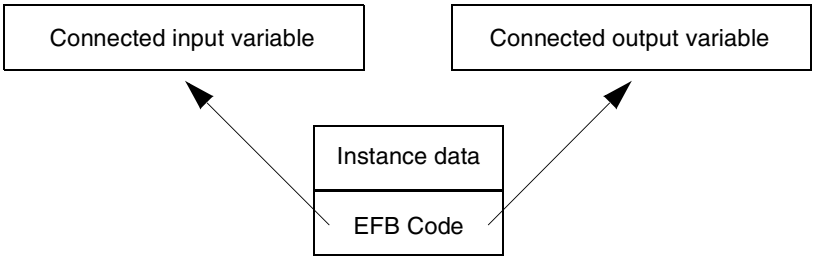
If an application is converted from Concept to Unity and uses this way of multi-assignment, the behavior may change in some use cases in a way that the output connected variable is no longer modifiable from another location.

Note: If the application uses multi-assignment on EFB outputs, you should carefully read the following chapter to verify that the converted application works in the intended way.

Concept behavior

Parameters are handled by reference

In Concept all function block parameters are handled by reference, means the blocks receives a pointer to the data of every function block pin and works directly on the connected variable.
Connected variables:



Function block code

Therefore in Concept it is up to the function block code to decide whether:

- to behave IEC compliant or
- to write input data or
- to read output data or
- not to write output data.

IEC demands

Function block

For the purposes of programmable controller programming languages, a function block is a program organization unit which, when executed, yields one or more values.
Multiple, named instances (copies) of a function block can be created.
Each instance shall have an associated identifier (the instance name), and a data structure containing its output and internal variables, and, depending on the implementation, values of or references to its input variables.
All the values of the output variables and the necessary internal variables of this data structure shall persist from one execution of the function block to the next.
Therefore, invocation of a function block with the same arguments (input variables) need not always yield the same output values.

Assignment of a value

Assignment of a value to an output variable of a function block is not allowed except from within the function block.
The assignment of a value to the input of a function block is permitted only as part of the invocation of the function block.
Unassigned or unconnected inputs of a function block shall keep their initialized values or the values from the latest previous invocation, if any.
Allowable usage of function block inputs and outputs are summarized in table below, using the function block FF75 of type SR.
The examples are shown in the ST language.

Usage	Inside function block	Outside function block
Input read	`IF IN1 THEN ...`	**Not allowed** [1, 2]
Input assignment	**Not allowed** [1]	`FB_INST(IN1:=A,IN2:=B);`
Output read	`OUT := OUT AND NOT IN2;`	`C := FB_INST.OUT;`
Output assignment	`OUT := 1;`	**Not allowed** [1]
In-out read	`IF INOUT THEN ...`	`IF FB1.INOUT THEN...`
In-out assignment	`INOUT := OUT OR IN1;` [3]	`FB_INST(INOUT:=D);`

1 Those usages listed as "not allowed" in this table could lead to implementation-dependent, unpredictable side effects.

2 Reading and writing of input, output and internal variables of a function block may be performed by the "communication function", "operator interface function", or the "programming, testing, and monitoring functions" defined in IEC 61131-1.

3 Modification within the function block of a variable declared in a VAR_IN_OUT block is permitted.

EN and ENO in function blocks

For function blocks also an additional Boolean EN (Enable) input or ENO (Enable Out) output, or both, can be provided by the manufacturer or user according to the declarations.
When these variables are used, the execution of the operations defined by the function block shall be controlled according to the following rules:

1. If the value of EN is FALSE (0) when the function block instance is invoked, the assignments of actual values to the function block inputs may or may not be made in an implementation-dependent fashion, the operations defined by the function block body shall not be executed and the value of ENO shall be reset to FALSE (0) by the programmable controller system.
2. Otherwise, the value of ENO shall be set to TRUE (1) by the programmable controller system, the assignments of actual values to the function block inputs shall be made and the operations defined by the function block body shall be executed. These operations can include the assignment of a Boolean value to ENO.
3. If the ENO output is evaluated to FALSE (0), the values of the function block outputs (VAR_OUTPUT) keep their states from the previous invocation.

In-out variables

In-out variables are a special kind of variable used with program organization units (POUs), i.e., functions, function blocks and programs.
They do not represent any data directly but reference other data of the appropriate type. They are declared by use of the VAR_IN_OUT keyword. In-out variables may be read or written to.
Inside a POU, in-out variables allow access to the original instance of a variable instead of a local copy of the value contained in the variable.

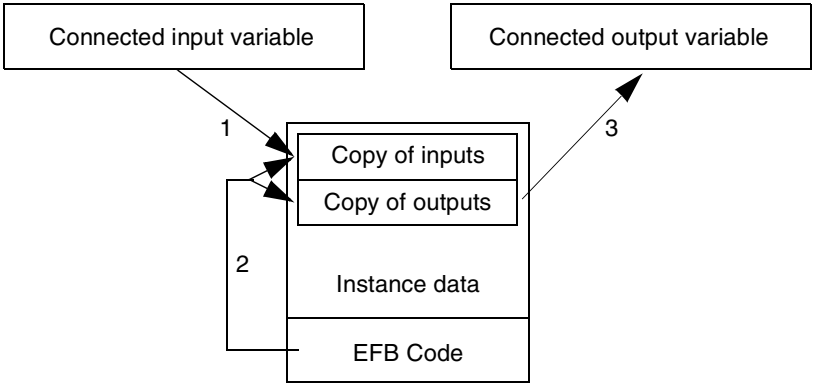
Function block invocation

A function block invocation establishes values for the function block's input variables and causes execution of the program code corresponding to the function block body. These values may be established graphically by connecting variables or the outputs of other functions or function blocks to the corresponding inputs, or textually by listing the value assignments to input variables.
If no value is established for a variable in the function block invocation, a default value is used.
Depending on the implementation, input variables may consist of the actual variable values, addresses at which to locate the actual variable values, or a combination of the two.
These values are always passed to the executing code in the data structure associated with the function block instance.
The results of function block execution are also returned in this data structure.
Hence, if the function block invocation is implemented as a procedure call, only a single argument - the address of the instance data structure - need be passed to the procedure for execution.

Unity behavior

Changed parameter handling

To fulfill the IEC demands the normal EDT (Elementary Data Types) parameter handling was changed from Concept to Unity.
The following figure describes the actual implementation in Unity.



The EFBs no longer get pointers to their connected pin variables.
They always get the data by value.
In every scan the application code updates the copy of the input data in the instance data, before the function block is called (1).
The copy of the pin data is located in the instance data of the block and the function block code always works on the instance data (2).
After the function block code execution the application code copies the updated function block output data from the instance data to the connected output variables (3).
This is valid for all EDTs. Derived data types and more complex data types are treated still by reference in some cases.

Addressing modes

The addressing mode of a Function Block element is directly linked to the type of the element.
The currents known addressing modes are:

- by value (VAL)
- by address (L-ADR)
- by address + Number of elements (L-ADR-LG)

Table with four columns and legend

-	EDT (Except STRING)	STRING	DDT Array	DDT Struct	ANY_ ARRAY	ANY...
Input parameter	VAL	L-ADR-LG	L-ADR-LG	L-ADR	L-ADR-LG	L-ADR-LG
Input_Output parameter	L-ADR [1]	L-ADR-LG	L-ADR-LG	L-ADR	L-ADR-LG	L-ADR-LG
Output parameter	VAL	VAL	L-ADR-LG	VAL	L-ADR-LG	L-ADR-LG
Public Variable	VAL	VAL	-	VAL	-	-
Private Variable	VAL	VAL	-	VAL	-	-

1 Except for BOOL type, the addressing mode is VAL.

Function Block invocation

The following rules must be taken into account while invoking a Function Block instance:

- All input_output parameters have to be filled
- All input parameters using the L-ADR or L-ADR-LG addressing modes have to filled
- All output parameters using the L-ADR or L-ADR-LG addressing modes have to filled

All other kind of parameters could be omitted while Function Block Instance invocation.
For input parameters, the following rules are applied (in the given order):

- The values of the previous invocation are used.
- If no previous invocation, the initial values are used.

Consequences

Potential problems

Because of this architectural change there might be trouble, when an application is migrated from Concept to Unity in the following cases:

- **Multi assignment of connected output variables:**
  In Concept there are function blocks, mainly in the closed-loop-control area, which do not write their output values to the connected variables in special operating modes (manual mode).
  In these special modes it was possible to write the variables from other locations inside the application.
  This will work in Unity only, if the variables are written after the function block call. If they are written before the function block call, the copy process from the instance data to the connected variables will overwrite this value with the old value from the instance data.
- **Controlling output variables by animation table or HMI:**
  If a block doesn't write his outputs in special operating modes (like manual mode, see above), it was possible to modify the connected output variables by animation tables or HMI.
  This will no longer work in Unity, since the copy process from the instance data to the connected variables of the function block will overwrite the modified value with the old value from the instance data.

Changed EFB layout

To avoid major problems, a lot of function blocks (mainly in the Motion and CLC area) were changed in their layout from Concept to Unity to ensure a correct mode of operation in the intended way for the function blocks.
The concerned pins were changed from type `OUT` to `IN/OUT`.
In nearly all cases the modification meets better the reality, since it is read from the concerned output pins and so they are in fact `IN/OUTs`.
The following tables summarize the EFBs, where at least one pin was changed from `OUT` to `IN/OUT` during migration from Concept to Unity.

Library CONT_CTL:

Family	Function Block	Concerned Pin
Controller	PI_B	OUT
	PIDFF	OUT
Output Processing	MS	OUT
Setpoint Management	SP_SEL	SP

Library Motion:

Family	Function Block	Concerned Pin
MMF Start	CFG_CP_F	MFB, CFG_BLK
	CFG_CP_V	MFB, CFG_BLK
	CFG_CS	MFB, CFG_BLK
	CFG_FS	MFB, CFG_BLK
	CFG_IA	MFB, CFG_BLK
	CFG_RA	MFB, CFG_BLK
	CFG_SA	MFB, CFG_BLK
	DRV_DNLD	MFB
	DRV_UPLD	MFB
	IDN_CHK	MFB
	IDN_XFER	MFB
	MMF_BITS	MFB
	MMF_ESUB	MFB
	MMF_INDX	MFB
	MMF_JOG	MFB
	MMF_MOVE	MFB
	MMF_RST	MFB
	MMF_SUB	MFB
	MMF_USUB	MFB

Library Obsolete Lib:

Family	Function Block	Concerned Pin
CLC_PRO	ALIM	Y
	COMP_PID	Y, YMAN_N, OFF_N, SP_CAS_N
	DERIV	Y
	INTEG	Y
	LAG	Y
	LAG2	Y
	LEAD_LAG	Y
	PD_OR_PI	Y
	PI	Y
	PID	Y
	PID_P	Y
	PIP	Y
	PPI	Y
	VLIM	Y
Extensions/ Compatibility	R2T	OFF
	SRCH	INDEX
	T2T	OFF

Concept Converter behavior

The Concept Converter normally handles the layout change in the following way, when a Concept application is imported into Unity:

- **Case 1: A variable is connected to the output pin in Concept:**
  The Concept Converter keeps the variable at the output side of the IN/OUT pin and adds the variable additionally at the input side of the pin.
- **Case 2: A link is connected to the output pin in Concept:**
  The Concept Converter removes the link, creates a new variable of the needed type and writes this new variable to the start and end position of the removed link. Additionally the variable is added to the input side of the pin.

Further potential problems

The following tables contain blocks, where also trouble may arise in case of multi-assignment, because in Concept:

- The blocks do not write their listed output pin in case of errors inside the block.
- The blocks do not write their listed output pin in `COLD` or `WARM INIT` scan.
- The blocks write their listed output pin conditionally depending from internal mode of operation.

Library CONT_CTL:

Family	Function Block	Concerned Pin
Conditioning	DTIME	OUT
	SCALING	OUT
	TOTALIZER	OUT, INFO
Controller	AUTOTUNE	TRI, INFO
	PI_B	OUT_D, DEV
	PIDFF	OUT_D, INFO
	STEP2	DEV
	STEP3	DEV
Output Processing	MS	OUTD, STATUS
	MS_DB	OUTD, STATUS
	SPLRG	OUT1, OUT2
Setpoint Management	RAMP	SP
	RATIO	KACT, SP
	SP_SEL	LSP_MEM

Library I/O Management:

Family	Function Block	Concerned Pin
Analog I/O Configurationj	I_SET	CHANNEL
	O_SET	CHANNEL
Analog I/O Scaling	I_NORM_WARN	WARN
	I_PHYS_WARN	WARN
	I_SCALE_WARN	WARN
Quantum I/O Configurationj	ACI040	CHANNL1..16
	ACO130	CHANNEL1..8
	AII330	CHANNEL1..8, INTERNAL
	AII33010	CHANNEL1..8
	AIO330	CHANNEL1..8
	ARI030	CHANNEL1..8

Library Motion:

Family	Function Block	Concerned Pin
MMF Start	CFG_CP_F	Q, ERROR
	CFG_CP_V	Q, ERROR
	CFG_CS	Q, ERROR
	CFG_FS	Q, ERROR
	CFG_IA	Q, ERROR
	CFG_RA	Q, ERROR
	CFG_SA	Q, ERROR
	DRV_DNLD	Q, ERROR, IDN_CNT
	DRV_UPLD	Q, ERROR, REG_CNT, DATA_B, LK
	IDN_CHK	Q, ERROR, NOT_EQ
	IDN_XFER	Q, ERROR, OUT_RAW, OUTCONV
	MMF_ESUB	Q, ERROR, RET1, RET2, RET§
	MMF_INDX	Q, ERROR
	MMF_JOG	Q, ERROR
	MMF_MOVE	Q, ERROR
	MMF_RST	Q
	MMF_SUB	Q, ERROR, RET1, RET2, RET§
	MMF_USUB	Q, ERROR, RET1, RET2, RET§

Library Obsolete Lib:

Family	Function Block	Concerned Pin
CLC	DELAY	Y
	PI1	ERR
	PID1	ERR
	PIDP1	ERR
	THREE_STEP_CON1	ERR_EFF
	THREEPOINT_CON1	ERR_EFF
	TWOPOINT_CON1	ERR_EFF
CLC_PRO	COMP_PID	STATUS, ERR
	DEADTIME	Y
	FGEN	Y, N
	INTEG	STATUS
	PCON2	ERR_EFF
	PCON3	ERR_EFF
	PD_OR_PI	ERR, STATUS
	PDM	Y_POS, Y_NEG
	PI	ERR, STATUS
	PID	ERR, STATUS
	PID_P	ERR, STATUS
	PIP	ERR, SP2, STATUS
	PPI	ERR, SP2, STATUS
	PWM	Y_POS, Y_NEG
	QPWM	Y_POS, Y_NEG
	SCON3	ERR_FF
	VLIM	STATUS
Extensions/ Compatibility	FIFO	EMPTY, FULL
	LIFO	EMPTY, FULL

Note: The pins were not changed, because in normal operation mode of the blocks this has no influence.

The Conversion Process

5

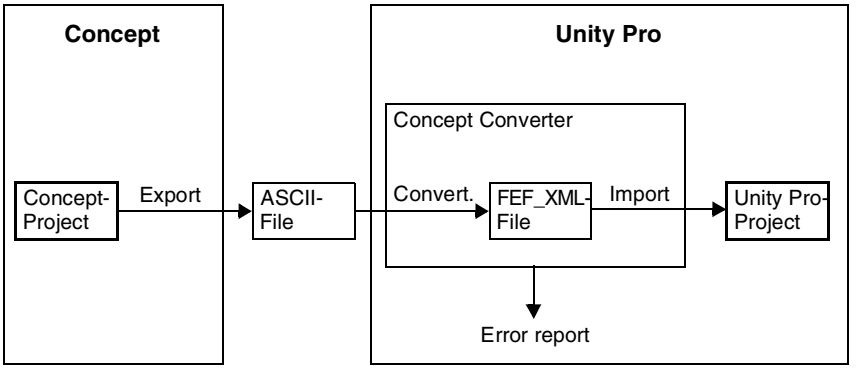
Conversion Process

General

A Concept project is exported from Concept and then converted automatically into a Unity Pro project using the Unity Pro Concept Converter.

Conversion process

Representation of the conversion process:



Description of the conversion levels:

Level	Description
1	A project is exported from Concept. An ASCII file is created.
2	The Unity Pro Concept Converter is called. The ASCII file is converted into a FEF-XML file.
3	The FEF-XML file is imported into Unity Pro. A Unity Pro project is created.
4	The error report is checked. There must be no errors.
5	The project is now available in Unity Pro and can be downloaded from there to a PLC, or can be edited in Unity Pro.

Error report and analysis

Errors that occur during conversion are logged in an error report and displayed in an output window.
Substitute objects are used in place of objects that cannot be converted, and messages are displayed in the output window to find these objects.
The Unity Pro project can be analyzed using the main menu **Build** → **Analyse Project**.
The errors displayed in the output window must be corrected manually to ensure the Unity Pro project runs correctly.

Conversion Procedure

6

Introduction

Overview

This chapter contains the procedures required to convert a Concept project into a Unity Pro project.

What's in this Chapter?

This chapter contains the following topics:

Exporting a Project from Concept

General

A Concept project that should be used in Unity Pro must first be exported from Concept. It is then possible to use the Unity Concept Converter to make the conversion to a Unity Pro project.

Export project

Perform the following steps to export a project:

Step	Procedure
1	Start the Concept Converter program from the Concept program group.
2	Select **File** → **Export...,** to open the menu for selecting the export range.
3	Select the export range: ● **Project with DFBs:** All project information including the DFBs and data structures (derived data types) used in the project are exported. ● **Project without DFBs:** All project information including all data structures (derived data types), but not DFBs and macros, is exported. **Result:** The dialog box for selecting the files to be exported is opened.
4	Select the following file extension: ● **Export projects:** Select the extention .prj from the format list box.
5	Select the project and confirm using **OK**. Result: The project is stored in the current directory as an ASCII file (.asc).
6	End the Concept Converter program using **File** → **Exit**.

Importing a Project into Unity Pro

General

A Concept project that should be used in Unity Pro must first be exported from Concept. It is then possible to use the Unity Concept Converter to make the conversion to a Unity Pro project.

Import project

Carry out the following steps to convert and import a project:

Step	Procedure
1	Launch Unity Pro.
2	Open the project exported from Concept using **File** → **Open**. Select the data type CONCEPT PROJECTS (*.ASC).
3	**Result:** The ASCII file is converted to Unity Pro source file format and imported automatically. Import errors and messages about objects that cannot be converted and have substitute objects in their place, are displayed in an output window.
4	Edit the errors and messages in the output window manually to ensure the Unity Pro project runs correctly.
5	To ensure that a project contains no more errors, select the menu command **Build** → **Analyse Project** again.

Blocks form Concept to Unity Pro

II

Introduction

Overview

This part contains a description of the blocks which are not part of Unity Pro as standard.
However, if these blocks were used in Concept they are generated during the project conversion from Concept to Unity Pro in order to map the functionality configured in Concept into Unity Pro on a one to one basis.

What's in this Part?

This part contains the following chapters:

DIOSTAT: Module function status (DIO)

7

Description

Function description

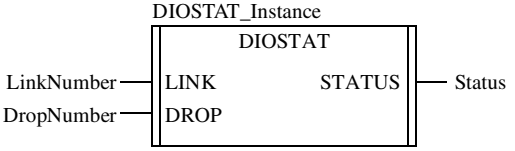
This function provides the function status for I/O modules of an I/O station (DIO). Each module (slot) is displayed as an output "status" bit. The bit on the far left side in "status" corresponds to the slot on the far left side of the I/O station.

Note: If a module of the I/O station is configured and works correctly, the corresponding bit is set to "1".

`EN` and `ENO` can be configured as additional parameters.

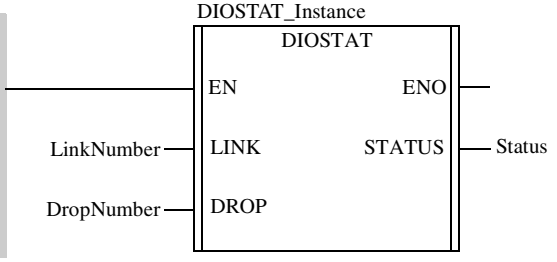
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL DIOSTAT_Instance (LINK:=LinkNumber, DROP:=DropNumber,
    STATUS=>Status)
```

Representation in ST

Representation:

```
DIOSTAT_Instance (LINK:=LinkNumber, DROP:=DropNumber,
    STATUS=>Status) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
LINK	UINT	Link No. (0...2)
DROP	UINT	I/O station no: (1...64)

Description of the output parameters:

Parameter	Data type	Meaning
STATUS	WORD	Status bit pattern (See *Function description, p. 69*) of an I/O station

RIOSTAT: Module function status (RIO)

8

Description

Function description

This function block provides the function status for I/O modules of an I/O station (local/remote I/O).
Quantum I/O or 800 I/O can be used.
An output `STATUSx` is allocated to each rack. Each module (slot) of this rack is characterized by a bit of the corresponding `STATUSx` output. The bit on the far left-hand side in `STATUSx` corresponds to the slot on the far left-hand side of the rack x.
Using `STATUS1` to `STATUS5`:

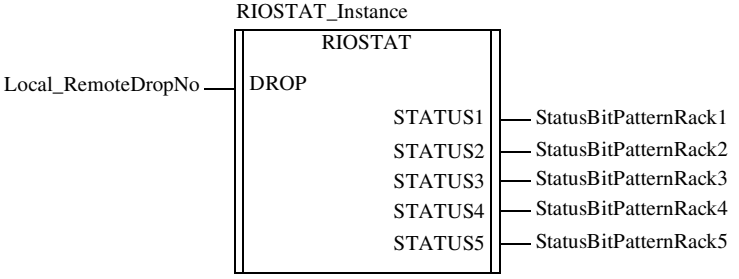
- **Quantum I/O**
  There is only one rack for an I/O station, e.g. only `STATUS1` is used.
- **800 I/O**
  There can be up to 5 racks for an I/O station, e.g. `STATUS1` corresponds to module rack 1, `STATUS5` corresponds to module rack 5.

Note: If a module on the module rack has been configured and works correctly, the corresponding bit is set to "1".

`EN` and `ENO` can be configured as additional parameters.

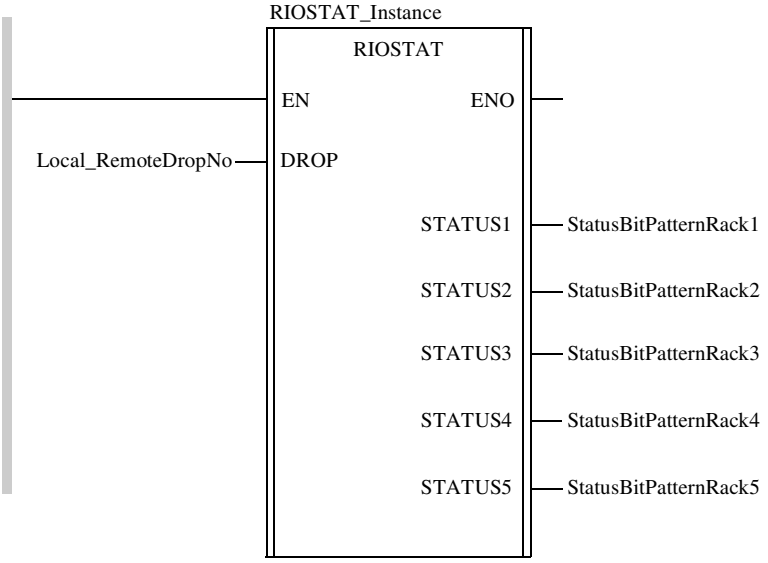
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL RIOSTAT_Instance (DROP:=Local_RemoteDropNo,
    STATUS1=>StatusBitPatternRack1,
    STATUS2=>StatusBitPatternRack2,
    STATUS3=>StatusBitPatternRack3,
    STATUS4=>StatusBitPatternRack4,
    STATUS5=>StatusBitPatternRack5)
```

Representation in ST

Representation:

```
RIOSTAT_Instance (DROP:=Local_RemoteDropNo,
    STATUS1=>StatusBitPatternRack1,
    STATUS2=>StatusBitPatternRack2,
    STATUS3=>StatusBitPatternRack3,
    STATUS4=>StatusBitPatternRack4,
    STATUS5=>StatusBitPatternRack5) ;
```

Parameter description

Description of the input parameters:

Parameters	Data type	Meaning
DROP	UINT	Local/remote I/O station no. (1...32)

Description of the output parameters:

Parameters	Data type	Meaning
STATUS1	WORD	Module rack 1 status bit pattern
STATUS2	WORD	Module rack 2 status bit pattern (800 I/O only)
...	...	...
STATUS5	WORD	Module rack 5 status bit pattern (800 I/O only)

READREG: Read register

9

Overview

Introduction

This chapter describes the READREG block.

What's in this Chapter?

This chapter contains the following topics:

Description

Function description

With a rising edge at the REQ input, this function block reads a register area from an addressed slave via Modbus Plus.
EN and ENO can be configured as additional parameters.

Note: When programming a READREG function, you must be familiar with the routing procedures used by your network. Modbus Plus routing path structures will be described in detail in "Modbus Plus Network Planning and Installation Guide".

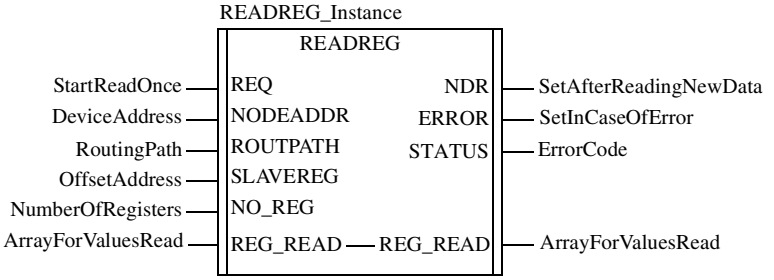
Note: This function block only supports the local Modbus Plus interface (no NOM). If using a NOM please work with the CREAD_REG block from the communication block library.

Note: This function block does not support TCP/IP- or SY/MAX-Ethernet. If TCP/IP- or SY/MAX-Ethernet is needed, please use the CREAD_REG block from the communication block library.

Note: Several copies of this function block can be used in the program. However, multiple instancing of these copies is not possible.

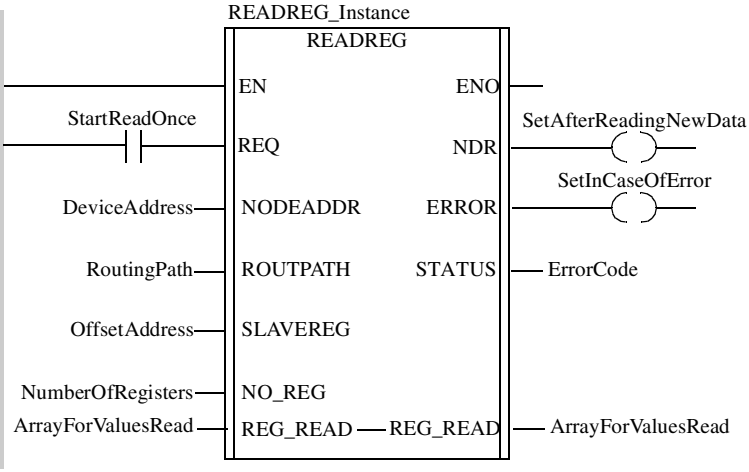
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL READREG_Instance (REQ:=StartReadOnce,
    NODEADDR:=DeviceAddress, ROUTPATH:=RoutingPath,
    SLAVEREG:=OffsetAddress, NO_REG:=NumberOfRegisters,
    REG_READ:=ArrayForValuesRead,
    NDR=>SetAfterReadingNewData, ERROR=>SetInCaseOfError,
    STATUS=>ErrorCode)
```

Representation in ST

Representation:

```
READREG_Instance (REQ:=StartReadOnce,
    NODEADDR:=DeviceAddress, ROUTPATH:=RoutingPath,
    SLAVEREG:=OffsetAddress, NO_REG:=NumberOfRegisters,
    REG_READ:=ArrayForValuesRead,
    NDR=>SetAfterReadingNewData, ERROR=>SetInCaseOfError,
    STATUS=>ErrorCode;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
REQ	BOOL	With a rising edge at the REQ input, this function block reads a register area from an addressed slave via Modbus Plus.
NODEADDR	INT	Device address within the target segment
ROUTPATH	DINT	Routing path to target segment
SLAVEREG	DINT	Offset address of the first 4x register in the slave to be read from
NO_REG	INT	Number of registers to be read from slave

Description of input / output parameters:

Parameters	Data type	Meaning
REG_READ	ANY_ARRAY_WORD	Writing data (For the file to be read a data structure must be declared as a located variable.)

Description of the output parameters:

Parameters	Data type	Meaning
NDR	BOOL	Set to "1" for one cycle after reading new data
ERROR	BOOL	Set to "1" for one scan in case of error
STATUS	WORD	Error Code

Mode of Functioning

Function mode of READREG_DFB blocks

Although a large number of READREG function blocks can be programmed, only four read operations may be active at the same time. It makes no difference whether these operations are performed using this function block or others (e.g. MBP_MSTR, CREAD_REG). All function blocks use one data transaction path and require multiple cycles to complete a task. The status signals NDR and ERROR report the function block state to the user program.
The complete routing information must be separated into two parts:

- in the NODEADDR of the destination node (regardless of whether it is located in the local segment or in another segment) and
- the routing path, in case there is a link via bridges.

The resulting destination address consists of these two information components. The routing path is a DINT data type, which is interpreted as a sequence of two-digit information units. It is not necessary to use "00" extensions (e.g. both routing paths 4711 and 47110000 are valid, for NODEADDR 34 the result is destination address 47.11.34.00.00).

Parameter description

REQ

A rising edge triggers the read transaction.
The parameter can be specified as an address, located variable, unlocated variable or literal.

NODEADDR

Identifies the node address within the target segment.
The parameter can be specified as an address, located variable, unlocated variable or literal.

ROUTPATH

Identifies the routing path to the target segment. The two-digit information units run from 01 64 (see *Mode of Functioning, p. 79*). If the slave resides in the local network segment, ROUTPATH must be set to "0" or must be left unconnected.
The parameter can be specified as an address, located variable, unlocated variable or literal.

SLAVEREG

Start of the area in the addressed slave from which the source data is read. The source area always resides within the 4x register area. SLAVEREG expects the source reference as offset within the 4x area. The leading "4" must be omitted (e.g. 59 (contents of the variables or value of the literal) = 40059).
The parameter can be specified as an address, located variable, unlocated variable or literal.

NO_REG	Number of registers to be read from slave processor (1 ... 100). The parameter can be specified as an address, located variable, unlocated variable or literal.
NDR	Transition to ON state for one program cycle signifies receipt of new data ready to be processed. The parameter can be specified as an address, located variable or unlocated variable.
ERROR	Transition to ON state for one program cycle signifies detection of a new error. The parameter can be specified as an address, located variable or unlocated variable.
STATUS	Error code, see *Modbus Plus Error Codes, p. 87* The parameter can be specified as an address, located variable or unlocated variable.
REG_READ	An ANY_ARRAY_WORD that is the same size as the requested transmission must be agreed upon (≥ NO_REG) for this parameter. The name of this array is defined as a parameter. If the array is defined too small, then only the amount of data is transmitted that is present in the array. The parameter must be defined as a located variable.

CREADREG: Continuous register reading

10

Overview

Introduction

This chapter describes the `CREADREG` block.

What's in this Chapter?

This chapter contains the following topics:

Description

Function description

This derived function block reads the register area continuously. It reads data from addressed nodes via Modbus Plus.
EN and ENO can be configured as additional parameters.

Note: It is necessary to be familiar with the routing procedures of your network when programming a CREADREG function. Modbus Plus routing path structures will be described in detail in "Modbus Plus Network Planning and Installation Guide".

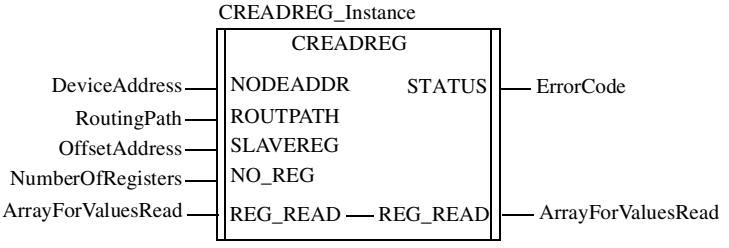
Note: This function block only supports the local Modbus Plus interface (no NOM). If using a NOM please work with the block CREAD_REG from the communication block library.

Note: This function block does not support TCP/IP- or SY/MAX-Ethernet.
If TCP/IP- or SY/MAX-Ethernet is needed, please use the block CREAD_REG of the communication block library.

Note: Several copies of this function block can be used in the program. However, multiple instancing of these copies is not possible.

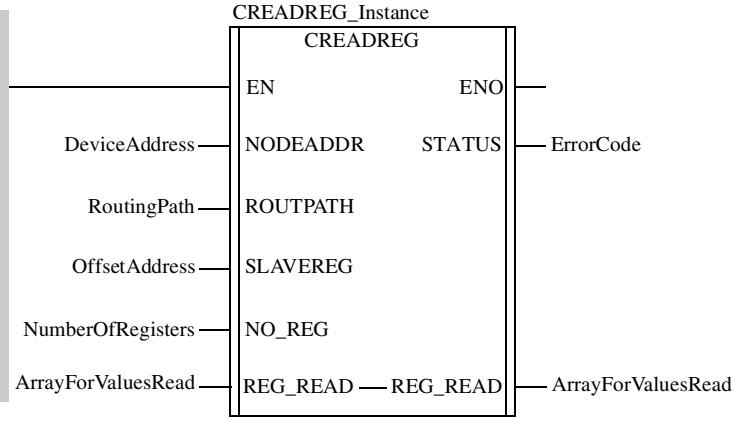
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL CREADREG_Instance (NODEADDR:=DeviceAddress,
    ROUTPATH:=RoutingPath, SLAVEREG:=OffsetAddress,
    NO_REG:=NumberOfRegisters,
    REG_READ:=ArrayForValuesRead,
    STATUS=>ErrorCode)
```

Representation in ST

Representation:

```
CREADREG_Instance (NODEADDR:=DeviceAddress,
    ROUTPATH:=RoutingPath, SLAVEREG:=OffsetAddress,
    NO_REG:=NumberOfRegisters,
    REG_READ:=ArrayForValuesRead,
    STATUS=>ErrorCode;
```

Parameter description

Description of the input parameters:

Parameters	Data type	Meaning
NODEADDR	INT	Device address within the target segment
ROUTPATH	DINT	Routing path to target segment
SLAVEREG	DINT	Offset address of the first 4x register in the slave to be read from
NO_REG	INT	Number of registers to be read from slave

Description of input / output parameters:

Parameters	Data type	Meaning
REG_READ	ANY_ARRAY_WORD	Writing data (For the file to be read a data structure must be declared as a located variable.)

Description of the output parameters:

Parameters	Data type	Meaning
STATUS	WORD	Error Code

Mode of Functioning

Function mode of CREADREG blocks

Although a large number of CREADREG function blocks can be programmed, only four read operations may be active at the same time. It makes no difference whether these operations are performed using this function block or others (e.g. MBP_MSTR, READREG). All function blocks use one data transaction path and require multiple cycles to complete a task.
The complete routing information must be separated into two parts:

- in the NODEADDR of the destination node (regardless of whether it is located in the local segment or in another segment) and
- the routing path, in case there is a link via network bridges.

The resulting destination address consists of these two information components. The routing path is a DINT data type, which is interpreted as a sequence of two-digit information units. It is not necessary to use "00" extensions (e.g. both routing paths 4711 and 47110000 are valid, for NODEADDR 34 the result is destination address 47.11.34.00.00).

Note: This function block puts a heavy load on the network. The network load must therefore be carefully monitored. If the network load is too high, the program logic should be reorganized to work with the READREG function block, which is a variant of this function block that does not operate in continuous mode, but is command driven.

Parameter description

NODEADDR

Identifies the node address within the target segment.
The parameter can be entered as an address, located variable, unlocated variable or literal.

ROUTPATH

Identifies the routing path to the target segment. The two-digit information units run from 01 64 (see *Mode of Functioning, p. 85*). If the slave resides in the local network segment, ROUTPATH must be set to "0" or must be left unconnected.
The parameter can be entered as an address, located variable, unlocated variable or literal.

SLAVEREG Start of the area in the addressed slave from which the source data are read. The source area always resides within the 4x register area. SLAVEREG expects the source reference as offset within the 4x area. The leading "4" must be omitted (e.g. 59 (contents of the variables or value of the literal) = 40059).
The parameter can be entered as an address, located variable, unlocated variable or literal.

NO_REG Number of registers to be read from slave processor (1 ... 100).
The parameter can be entered as an address, located variable, unlocated variable or literal.

STATUS Error code, see *Modbus Plus Error Codes, p. 87*
The parameter can be specified as an address, located variable or unlocated variable.

REG_READ An ANY_ARRAY_WORD that is the same size as the requested transmission must be agreed upon (≥ NO_REG) for this parameter. The name of this array is defined as a parameter. If the array is defined too small, then only the amount of data is transmitted that is present in the array.
The parameter must be defined as a located variable.

Modbus Plus Error Codes

Form of the function error code

The form of the function error code for Modbus Plus is **Mmss**, which includes:

- **M** is the high code
- **m** is the low code
- **ss** is a subcode

Hexadecimal error code

Hexadecimal error code for Modbus Plus:

Hex. Error Code	Meaning
1001	Abort by user
2001	An operation type that is not supported was specified in the control block
2002	One or more control block parameters were modified while the `MSTR` element was active (this only applies to operations which require several cycles for completion). Control block parameters my only be modified in inactive `MSTR` components.
2003	Illegal value in the length field of the control block
2004	Illegal value in the offset field of the control block
2005	Illegal value in the length and offset fields of the control block
2006	Unauthorized data field on slave
2007	Unauthorized network field on slave
2008	Unauthorized network routing path on slave
2009	Routing path equivalent to own address
200A	Attempting to retrieve more global data words than available
30ss	Unusual response by Modbus slave (See *ss hexadecimal value in 30ss error code, p. 88*)
4001	Inconsistent response by Modbus slave
5001	Inconsistent response by network
6mss	Routing path error (See *ss hexadecimal value in 6mss error code, p. 88*) Subfield m shows where the error occurred (a 0 value means local node, 2 means 2nd device in route, etc) .

ss hexadecimal value in 30ss error code

ss hexadecimal value in 30ss error code:

ss hex. Value	Meaning
01	Slave does not support requested operation
02	Non-existent slave registers were requested
03	An unauthorized data value was requested
05	Slave has accepted a lengthy program command
06	Function cannot currently be carried out: lengthy command running
07	Slave has rejected lengthy program command

ss hexadecimal value in 6mss error code

Note: Subfield m in error code 6mss is an `Index` in the routing information that shows where an error has been detected (a 0 value indicates the local node, 2 means the second device in the route, etc.).

The ss subfield in error code 6mss is as follows:

ss hex. Value	Meaning
01	No response receipt
02	Access to program denied
03	Node out of service and unable to communicate
04	Unusual response received
05	Router-node data path busy
06	Slave out of order
07	Wrong destination address
08	Unauthorized node type in routing path
10	Slave has rejected the command
20	Slave has lost an activated transaction
40	Unexpected master output path received
80	Unexpected response received
F001	Wrong destination node specified for `MSTR` operation

WRITEREG: Write register

11

Overview

Introduction

This chapter describes the `WRITEREG` block.

What's in this Chapter?

This chapter contains the following topics:

Description

Function description

With a rising edge at the REQ input, this function block writes a register area from the PLC to an addressed slave via Modbus Plus.
EN and ENO can be configured as additional parameters.

Note: When programming a WRITEREG function, you must be familiar with the routing procedures used by your network. Modbus Plus routing path structures will be described in detail in "Modbus Plus Network Planning and Installation Guide".

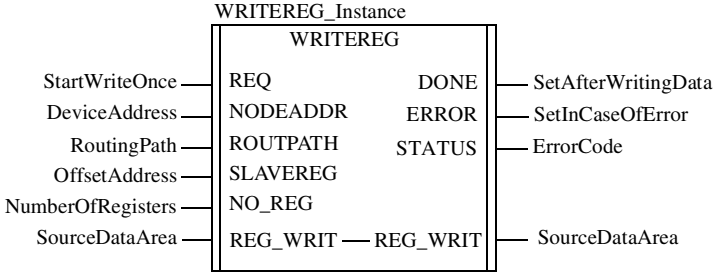
Note: This derived function block only supports the local Modbus Plus interface (no NOM).
If using a NOM please work with the WRITE_REG block from the communication block library.

Note: This derived function block also does not support TCP/IP- or SY/MAX-Ethernet.
If TCP/IP- or SY/MAX-Ethernet is needed, please use the WRITE_REG block from the communication block library.

Note: Several copies of this function block can be used in the program. However, multiple instancing of these copies is not possible.

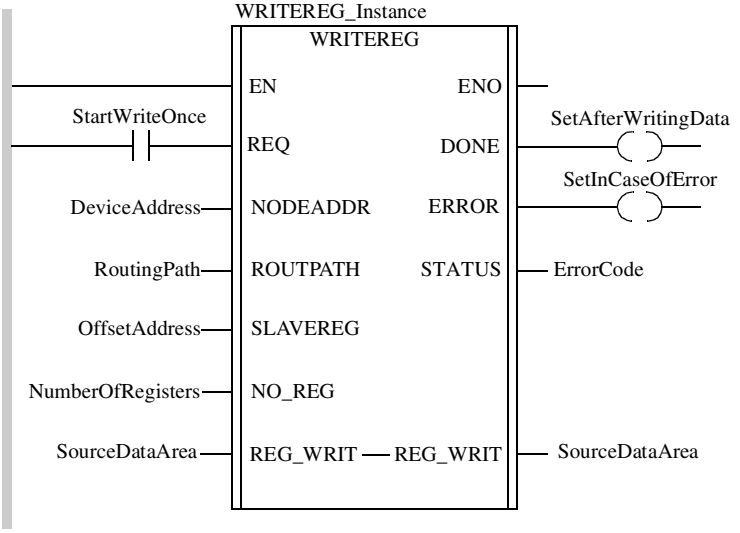
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL WRITEREG_Instance (REQ:=StartWriteOnce,
    NODEADDR:=DeviceAddress, ROUTPATH:=RoutingPath,
    SLAVEREG:=OffsetAddress, NO_REG:=NumberOfRegisters,
    REG_WRIT:=SourceDataArea,
    DONE=>SetAfterWritingData,ERROR=>SetInCaseOfError,
    STATUS=>ErrorCode)
```

Representation in ST

Representation:

```
WRITEREG_Instance (REQ:=StartWriteOnce,
    NODEADDR:=DeviceAddress, ROUTPATH:=RoutingPath,
    SLAVEREG:=OffsetAddress, NO_REG:=NumberOfRegisters,
    REG_WRIT:=SourceDataArea,
    DONE=>SetAfterWritingData,ERROR=>SetInCaseOfError,
    STATUS=>ErrorCode) ;
```

Parameter description

Description of input parameters:

Parameter	Data type	Meaning
REQ	BOOL	With a rising edge at the REQ input, this function block writes a register area from the PLC to an addressed slave via Modbus Plus.
NODEADDR	INT	Device address within the target segment
ROUTPATH	DINT	Routing path to target segment
SLAVEREG	DINT	Offset address of the first 4x register in the slave to be written to
NO_REG	INT	Number of registers to be written from slave

Description of input / output parameters:

Parameters	Data type	Meaning
REG_WRIT	ANY_ARRAY_WORD	Source data field (A data structure must be declared as a located variable for the source file.)

Description of the output parameters:

Parameters	Data type	Meaning
DONE	BOOL	Set to "1" for one scan after writing data
ERROR	BOOL	Set to "1" for one scan in case of error
STATUS	WORD	Error Code

Mode of Functioning

Function mode of WRITEREG blocks

Although a large number of WRITEREG function blocks can be programmed, only four write operations may be active at the same time. It makes no difference whether these operations are performed using this function block or others (e.g. MBP_MSTR, CWRITE_REG). All function blocks use one data transaction path and require multiple cycles to complete a task.
If several WRITEREG function blocks are used within an application, they must at least differ in the values of their NO_REG or REG_WRIT parameters.

The status signals DONE and ERROR report the function block state to the user program.

The complete routing information must be separated into two parts:
- in the NODEADDR of the destination node (regardless of whether it is located in the local segment or in another segment) and
- the routing path, in case there is a link via network bridges.

The resulting destination address consists of these two information components. The routing path is a DINT data type, which is interpreted as a sequence of two-digit information units. It is not necessary to use "00" extensions (e.g. both routing paths 4711 and 47110000 are valid, for NODEADDR 34 the result is destination address 47.11.34.00.00).

Parameter description

REQ

A rising edge triggers the write transaction.
The parameter can be entered as an address, located variable, unlocated variable or literal.

NODEADDR

Identifies the node address within the target segment.
The parameter can be entered as an address, located variable, unlocated variable or literal.

ROUTPATH

Identifies the routing path to the target segment. The two-digit information units run from 01 64 (see *Mode of Functioning, p. 93*). If the slave resides in the local network segment, ROUTPATH must be set to "0" or must be left unconnected.
The parameter can be entered as an address, located variable, unlocated variable or literal.

SLAVEREG	Start of the destination area in the addressed slave to which the source data is written. The destination area always resides within the 4x register area. SLAVEREG expects the destination address as an offset within the 4x area. The leading "4" must be omitted (e.g. 59 (contents of the variables or value of the literal) = 40059). The parameter can be entered as an address, located variable, unlocated variable or literal.
NO_REG	Number of registers to be written to slave processor (1 ... 100). The parameter can be entered as an address, located variable, unlocated variable or literal.
REG_WRIT	An ANY_ARRAY_WORD that is the same size as the planned transmission must be agreed upon (≥ NO_REG) for this parameter. The name of this array is defined as a parameter. If the array is defined too small, then only the amount of data is transmitted that is present in the array. The parameter must be defined as a located variable.
DONE	Transition to ON state for one program scan signifies data have been transferred. The parameter can be entered as an address, located variable or unlocated variable.
ERROR	Transition to ON state for one program cycle signifies detection of a new error. The parameter can be specified as an address, located variable or unlocated variable.
STATUS	Error code, see *Modbus Plus Error Codes, p. 87* The parameter can be specified as an address, located variable or unlocated variable.

CWRITREG: Continuous register writing

12

Overview

Introduction

This chapter describes the `CWRITREG` block.

What's in this Chapter?

This chapter contains the following topics:

Description

Function description

This derived function block writes continuously to the register area. It transfers data from the PLC via Modbus Plus to a specified slave destination processor.
EN and ENO can be configured as additional parameters.

Note: When programming a CWRITREG function, you must be familiar with the routing procedures used by your network. Modbus Plus routing path structures will be described in detail in "Modbus Plus Network Planning and Installation Guide".

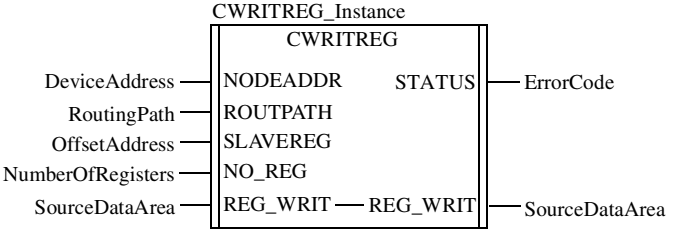
Note: This function block only supports the local Modbus Plus interface (no NOM). If using a NOM please work with the CWRITE_REG block from the communication block library.

Note: This function block does not support TCP/IP- or SY/MAX-Ethernet. If TCP/IP- or SY/MAX-Ethernet is needed, please use the CWRITE_REG block from the communication block library.

Note: Several copies of this function block can be used in the program. However, multiple instancing of these copies is not possible.

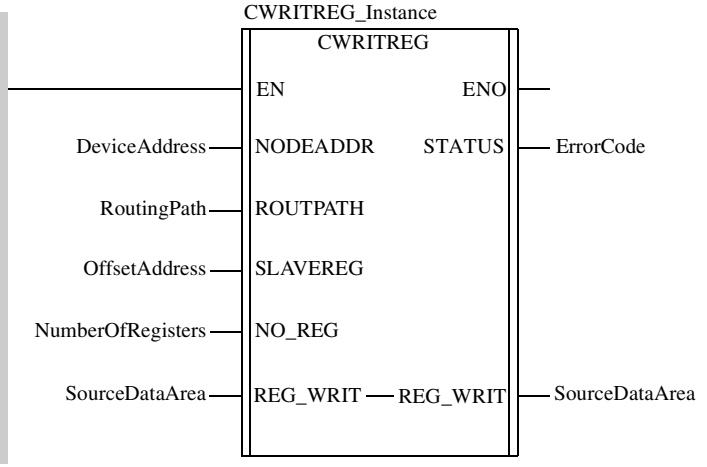
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL CWRITREG_Instance (NODEADDR:=DeviceAddress,
    ROUTPATH:=RoutingPath, SLAVEREG:=OffsetAddress,
    NO_REG:=NumberOfRegisters,
    REG_WRIT:=SourceDataArea,
    STATUS=>ErrorCode)
```

Representation in ST

Representation:

```
CWRITREG_Instance (NODEADDR:=DeviceAddress,
    ROUTPATH:=RoutingPath, SLAVEREG:=OffsetAddress,
    NO_REG:=NumberOfRegisters,
    REG_WRIT:=SourceDataArea,
    STATUS=>ErrorCode) ;
```

Parameter description

Description of the input parameters:

Parameters	Data type	Meaning
NODEADDR	INT	Device address within the target segment
ROUTPATH	DINT	Routing path to target segment
SLAVEREG	DINT	Offset address of the first 4x register in the slave to be written to
NO_REG	INT	Number of registers to be written from slave

Description of input / output parameters:

Parameters	Data type	Meaning
REG_WRIT	ANY_ARRAY_WORD	Source data field (A data structure must be declared as a located variable for the source file.)

Description of the output parameters:

Parameters	Data type	Meaning
STATUS	WORD	Error Code

Mode of Functioning

Function mode of CWRITREG blocks

Although an unlimited number of CWRITREG function blocks can be programmed, only four write operations may be active at the same time. It makes no difference whether these operations are performed using this function block or others (e.g. MBP_MSTR, WRITEREG). All function blocks use one data transaction path and require multiple cycles to complete a task.
If several CWRITREG function blocks are used within an application, they must at least differ in the values of their NO_REG or REG_WRIT parameters.

The complete routing information must be separated into two parts:

- in the NODEADDR of the destination node (regardless of whether it is located in the local segment or in another segment) and
- the routing path, in case there is a link via network bridges.

The resulting destination address consists of these two information components. The routing path is a DINT data type, which is interpreted as a sequence of two-digit information units. It is not necessary to use "00" extensions (e.g. both routing paths 4711 and 47110000 are valid, for NODEADDR 34 the result is destination address 47.11.34.00.00).

Note: This function block puts a heavy load on the network. The network load must therefore be carefully monitored. If the network load is too high, the program logic should be reorganized to work with the WRITEREG function block, which is a variant of this function block that does not operate in continuous mode, but is command driven.

Parameter description

NODEADDR	Identifies the node address within the target segment. The parameter can be specified as an address, located variable, unlocated variable or literal.
ROUTPATH	Identifies the routing path to the target segment. The two-digit information units run from 01 64 (see *Mode of Functioning, p. 99*). If the slave resides in the local network segment, ROUTPATH must be set to "0" or must be left unconnected. The parameter can be specified as an address, located variable, unlocated variable or literal.
SLAVEREG	Start of the destination area in the addressed slave to which the source data are written. The destination area always resides within the 4x register area. SLAVEREG expects the destination address as an offset within the 4x area. The leading "4" must be omitted (e.g. 59 (contents of the variables or value of the literal) = 40059). The parameter can be entered as an address, located variable, unlocated variable or literal.
NO_REG	Number of registers to be written to slave processor (1 ... 100). The parameter can be specified as an address, located variable, unlocated variable or literal.
REG_WRIT	An ANY_ARRAY_WORD that is the same size as the planned transmission must be agreed upon (≥ NO_REG) for this parameter. The name of this array is defined as a parameter. If the array is defined too small, then only the amount of data is transmitted that is present in the array. The parameter must be defined as a located variable.
STATUS	If MSTR error code is returned, see *Modbus Plus Error Codes, p. 87* The parameter can be specified as an address, located variable or unlocated variable.

LOOKUP_TABLE1_DFB: Traverse progression with 1st degree interpolation

13

Overview

Introduction

This chapter describes the LOOKUP_TABLE1_DFB block.

What's in this Chapter?

This chapter contains the following topics:

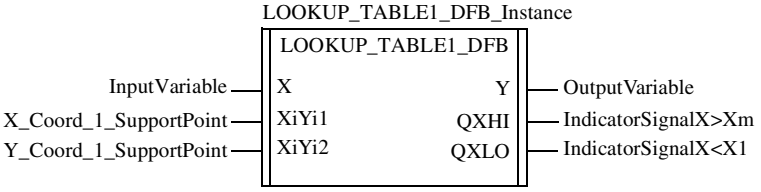
Description

Function description

This function block linearizes characteristic curves by means of interpolation. The function block works with variable support point width.
The number of `XiYi` inputs can be increased to 30 by modifying the size of the block frame vertically. This corresponds to a maximum of 15 support point pairs.
The number of inputs must be even.
The `X` values must be in ascending order.
`EN` and `ENO` can be configured as additional parameters.

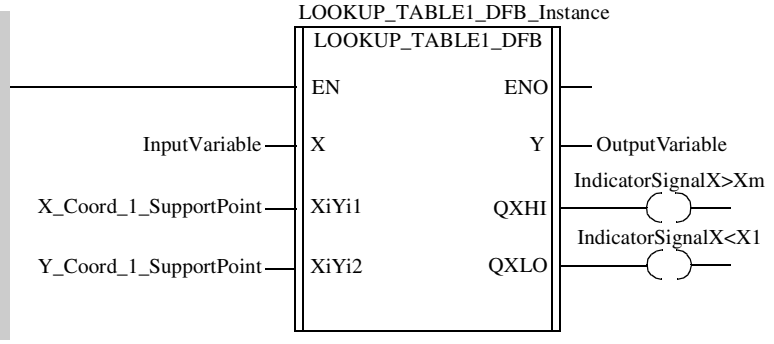
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL LOOKUP_TABLE1_DFB_Instance (X:=InputVariable,
    XiYi1:=X_Coord_1_SupportPoint,
    XiYi2:=Y_Coord_1_SupportPoint, Y=>OutputVariable,
    QXHI=>IndicatorSignalX>Xm, QXLO=>IndicatorSignalX<X1)
```

Representation in ST

Representation:

```
LOOKUP_TABLE1_DFB_Instance (X:=InputVariable,
    XiYi1:=X_Coord_1_SupportPoint,
    XiYi2:=Y_Coord_1_SupportPoint, Y=>OutputVariable,
    QXHI=>IndicatorSignalX>Xm, QXLO=>IndicatorSignalX<X1) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
XiYi1	REAL	X coordinate 1. Support point
XiYi2	REAL	Y coordinate 1. Support point
XiYin	REAL	X coordinate m/2. Support point
XiYim	REAL	Y coordinate m/2. Support point
X	REAL	Input variable

Description of the output parameters:

Parameter	Data type	Meaning
Y	REAL	Output variable
QXHI	BOOL	Indicator: X > Xm
QXLO	BOOL	Indicate X < X1

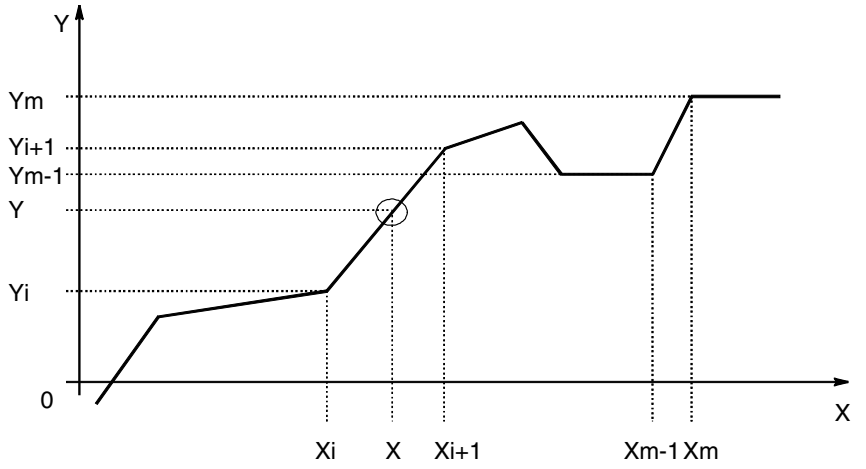
Detailed description

Parameter description

Each two sequential inputs (XiYi) represent a support point pair. The first input XiYi corresponds to X1, the next one to Y1, the one after that to X2, etc.
For all types of input value in X found between these support points, the corresponding Y output value is interpolated, while the traverse progression between the support points is viewed linearly.
For $X < X_1$ is $Y = Y_1$
For $X > X_m$ is $Y = Y_m$
If the value at input X is higher than the value of the last support point Xm, the output QXHI becomes "1".
If the value at input X is less than the value of the first support point X1, the output QXLO becomes "1".

Principle of interpolation

Traverse progression with 1st degree interpolation)



Interpolation

The following algorithm applies to a point Y:

$$Y = Y_i + \frac{Y_i + 1 - Y_i}{X_i + 1 - X_i} \times (X - X_i)$$

for $X_i \leq X \leq X_{i+1}$ and i = 1 ... (m-1)
Assuming: $X_1 \leq X_2 \leq ... \leq X_i \leq X_{i+1} \leq ... \leq X_{m-1} \leq X_m$

The X values must be in ascending order.
Two consecutive X values can be identical. This could cause a discrete curve progression.
In this instance, the special case applies:
$Y = 0.5 \times (Y_i + Y_{i+1})$
for
$X_i = X = X_{i+1}$ and i = 1 ... (m-1)

PLCSTAT: PLC function status

14

Overview

Introduction

This chapter describes the PLCSTAT block.

What's in this Chapter?

This chapter contains the following topics:

Description

Function description

This derived function block reads the Quantum PLC internal states and error bits and copies this data to the data structures allocated to the respective outputs.

EN and ENO can be configured as additional parameters.
Only data with the input bit (PLC_READ, RIO_READ, DIO_READ) set to "1" will be read.

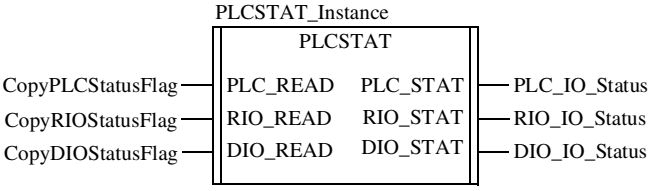
Evaluation

The evaluation of PLC_STAT (PLC status), RIO_STAT (I/O status) and DIO_STAT (I/O communications status) is possible.

Note: The name of the output DIO_STAT is confusing. This output only relates to the remote I/O Drop Status Information (S908) and not to the Distributed I/O status. To read the distributed I/O status use the function block DIOSTAT (See *DIOSTAT: Module function status (DIO), p. 69*).

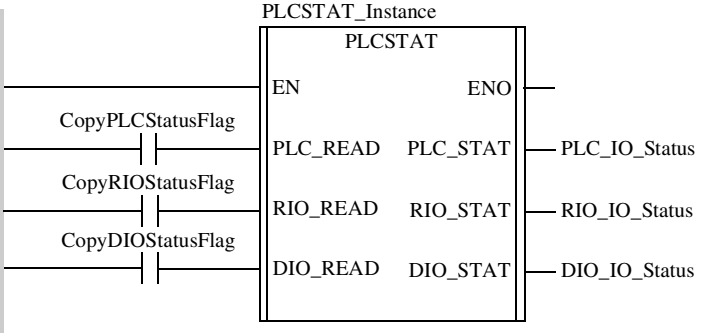
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL PLCSTAT_Instance (PLC_READ:=CopyPLCStatusFlag,
    RIO_READ:=CopyRIOStatusFlag,
    DIO_READ:=CopyDIOStatusFlag,
    PLC_STAT=>PLC_IO_Status, RIO_STAT=>RIO_IO_Status,
    DIO_STAT=>DIO_IO_Status)
```

Representation in ST

Representation:

```
PLCSTAT_Instance (PLC_READ:=CopyPLCStatusFlag,
    RIO_READ:=CopyRIOStatusFlag,
    DIO_READ:=CopyDIOStatusFlag,
    PLC_STAT=>PLC_IO_Status, RIO_STAT=>RIO_IO_Status,
    DIO_STAT=>DIO_IO_Status) ;
```

PLCSTAT parameter description

Description of the input parameters:

Parameters	Data type	Meaning
PLC_READ	BOOL	1 = copies the PLC status from the status table to the output PLC_STAT.
RIO_READ	BOOL	1 = copies the RIO status from the status table to the output RIO_STAT.
DIO_READ	BOOL	1 = copies the DIO status from the status table to the output DIO_STAT.

Description of the output parameters:

Parameters	Data type	Meaning
PLC_STAT	PLCSTATE,	Contains the PLC status.
RIO_STAT	RIOSTATE,	Contains the RIO status (I/O status) for Quantum
DIO_STAT	DIOSTATE,	Contains the DIO status (I/O communication status) **Note:** The name of this output is confusing. This output only relates to the remote I/O Drop Status Information (S908) and not to the Distributed I/O status. To read the distributed I/O status use the function block DIOSTAT (See *DIOSTAT: Module function status (DIO), p. 69*).

Derived Data Types

Element description PLCSTATE

Description of the PLCSTATE element:

Element	Data type	Meaning
word1	WORD	CPU status
word2	WORD	Hot Standby Status
word3	WORD	PLC status
word4	WORD	RIO Status
word5	WORD	Reserve
word6	WORD	Reserve
word7	WORD	Reserve
word8	WORD	Reserve
word9	WORD	Reserve
word10	WORD	Reserve
word11	WORD	Reserve

Element description RIOSTATE

Description of the RIOSTATE element

Element	Data type	Meaning
word1	WORD	I/O station 1, module rack 1
word2	WORD	I/O station 1, module rack 2
...	...	...
word5	WORD	I/O station 1, module rack 5
word6	WORD	I/O station 2, module rack 1
word7	WORD	I/O station 2, module rack 2
...	...	...
word160	WORD	I/O station 32, module rack 5

Element description
DIOSTATE

Description of the DIOSTATE element

Element	Data type	Meaning
word1	WORD	Switch on error numbers:
word2	WORD	Cable A error
word3	WORD	Cable A error
word4	WORD	Cable A error
word5	WORD	Cable B error
word6	WORD	Cable B error
word7	WORD	Cable B error
word8	WORD	Global communication status
word9	WORD	Global cumulative error counter for cable A
word10	WORD	Global cumulative error counter for cable B
word11	WORD	I/O station 1 health status and repetition counter (first word)
word12	WORD	I/O station 1 health status and repetition counter (second word)
word13	WORD	I/O station 1 health status and repetition counter (third word)
word14	WORD	I/O station 2 health status and repetition counter (first word)
...	...	...
word104	WORD	I/O station 32 health status and repetition counter (first word)
word105	WORD	I/O station 32 health status and repetition counter (second word)
word106	WORD	I/O station 32 health status and repetition counter (third word)

PLC status (PLC_STAT)

General information

Note: Information corresponds to status table words 1 to 11 in the dialog **PLC status**.

The conditions are true when the bits are set to 1.

PLC status (PLCSTATE: word1)

Bit allocation:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
10	Run light OFF
11	Memory protect OFF
12	Battery failed

Hot Standby status (PLCSTATE: word2)

Bit allocation:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	CHS 110/S911/R911 present and OK
11	0 = CHS shift switch set to A 1 = CHS shift switch set to B
12	0 = PLCs have equal logic 1 = PLCs have unequal logic
13, 14	Remote system condition Dec binary 1 0 1 = Offline 2 1 0 = Primary 3 1 1 = Standby
15, 16	Local system condition Dec binary 1 0 1 = Offline 2 1 0 = Primary 3 1 1 = Standby

PLC status (`PLCSTATE: word3`)

Bit allocation:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	First cycle

RIO status (`PLCSTATE: word4`)

Bit allocation:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	IOP defect
2	IOP timeout
3	IOP Loopback
4	IOP memory disturbance
13-16	00 IO has not responded 01 no response 02 Loopback defect

RIO status (RIO_STAT) for Quantum

General information

Note: The information corresponds to status table words 12 to 171 in the PLC status dialog.

The words show the I/O module function status.
Five words are reserved for each of the maximum 32 I/O stations. Each word corresponds to one of maximal 2 possible module racks in each I/O station.

Function display for Quantum hardware

Each of the module racks for Quantum hardware can contain up to 15 I/O modules (except for the first rack which contains a maximum 14 I/O modules). Bit 1... 16 in each word show the corresponding I/O module function display in the racks.

I/O module function status

Bit allocation:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	Slot 1
2	Slot 2
...	...
16	Slot 16

Conditions for a correct function display

Four conditions must be fulfilled if an I/O module can give a correct function display:

- The data traffic of the slot has to be monitored.
- The slot must be valid for the inserted module.
- Valid communication must be established between the module and the RIO interface at RIO stations.
- Valid communication must be established between the I/O processor in the PLC and the RIO interface at the RIO station.

Status words for the MMI user controllers

The status of the 32 element button controllers and PanelMate units in a RIO network can also be monitored with an I/O function status word. The button controllers are located on slot 4 in a I/O rack and can be monitored at bit 4 of the corresponding status word. A PanelMate on RIO is located on slot 1 in module rack 1 of the I/O station and can be monitored at bit 1 of the first status word for the I/O station.

Note: The ASCII keyboard communication status can be monitored with the error numbers in the ASCII read/write instructions.

DIO status (DIO_STAT)

General information

Note: The information corresponds to status table words 172 to 277 in the PLC status dialog.

The words contain the I/O communication status (DIO status) Words 1 to 10 are global status words. Of the remaining 96 words, three words are allocated to each of the up to 32 I/O stations.
word1 saves the switch on error numbers. This word is always 0 when the system is running. If an error occurs, the PLC does not start but generates a PLC stop status (word5 from PLC_STAT).
The conditions are true when the bits are set to 1.

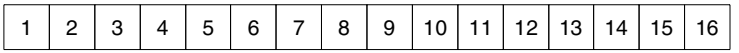
Switch on error numbers (`DIOSTATE word1`)

The conditions are true when the bits are set to 1.
Switch on error numbers:

Code	Error	Meaning (location of error)
01	BADTCLEN	Traffic cop length
02	BADLNKNUM	RIO link number
03	BADNUMDPS	I/O station number in traffic cop
04	BADTCSUM	Traffic cop checksum
10	BADDDLEN	I/O station descriptor length
11	BADDRPNUM	I/O station number
12	BADHUPTIM	I/O station stop time
13	BADASCNUM	ASCII port number
14	BADNUMODS	Module number in I/O station
15	PRECONDRP	I/O station is already configured
16	PRECONPRT	Port is already configured
17	TOOMNYOUT	More than 1024 output locations
18	TOOMNYINS	More than 1024 input points
20	BADSLTNUM	Module slot address
21	BADRCKNUM	Rack address
22	BADOUTBC	Number of output bytes
23	BADINBC	Number of input bytes
25	BADRF1MAP	First reference number
26	BADRF2MAP	Second reference number
27	NOBYTES	No input or output bytes
28	BADDISMAP	I/O marker bit not at 16 bit limit
30	BADODDOUT	Unmated, odd output module
31	BADODDIN	Unmated, odd input module
32	BADODDREF	Unmated odd module reference
33	BAD3X1XRF	1x-reference after 3x-register
34	BADDMYMOD	Dummy module reference already in use
35	NOT3XDMY	3x-module is not a dummy module
36	NOT4XDMY	4x-module is not a dummy module
40	DMYREAL1X	Dummy module, then real 1x-module
41	REALDMY1X	Real, then 1x-dummy module
42	DMYREAL3X	Dummy module, then real 3x-module
43	REALDMY3X	Real, then 3x-dummy module

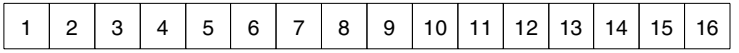
Status of cable A (`DIOSTATE: word2, word3, word4`)

Bit allocation for `word2`:



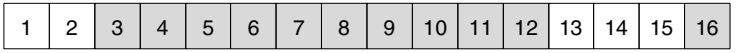
Bit	Allocation
1 - 8	Counts frame fields
9 - 16	Counts DMA receiver overflows

Bit allocation for `word3`:



Bit	Allocation
1 - 8	Counts receiver errors
9 - 16	Counts I/O station receiver failures

Bit allocation for `word4`:



Bit	Allocation
1	1 = frame too short
2	1 = no frame end
13	1 = CRC error
14	1 = alignment error
15	1 = overflow error

Status of cable B (`DIOSTATE: word5, word6, word7`)

Bit allocation for `word5`:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Counts frame fields
9 - 16	Counts DMA receiver overflows

Bit allocation for `word6`:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Counts receiver errors
9 - 16	Counts I/O station receiver failures

Bit allocation for `word7`:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	1 = frame too short
2	1 = no frame end
13	1 = CRC error
14	1 = alignment error
15	1 = overflow error

Global communication status (DIOSTATE: word8)

The conditions are true when the bits are set to 1.
Bit allocation for word8:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	Comm. function display
2	Cable A status
3	Cable B status
5 - 8	Communication counter lost
9 - 16	Cumulative repetition counter

Global cumulative error counter for cable A (DIOSTATE: word9)

The conditions are true when the bits are set to 1.
Bit allocation for word9:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Counts recognized errors
9 - 16	Counts zero responses

Global cumulative error counter for cable B(DIOSTATE: word10)

The conditions are true when the bits are set to 1.
Bit allocation for word10:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Counts recognized errors
9 - 16	Counts zero responses

RIO status (`DIOSTATE`: `word11` to `word106`)

Words 11 to 106 are used to describe the RIO station status, three status words are planned for each I/O station.
The **first** word in each group of three shows the communication status for the corresponding I/O station:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	Communication health
2	Cable A status
3	Cable B status
5 - 8	Counter for lost communications
9 - 16	Cumulative repetition counter

The **second** word in each group of three is the cumulative I/O station error counter at cable A for the corresponding I/O station:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Minimum one error in words 2 to 4
9 - 16	Counts zero responses

The **third** word in each group of three is the cumulative I/O station error counter at cable B for the corresponding I/O station:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1 - 8	Minimum one error in words 5 to 7
9 - 16	Counts zero responses

Note: For PLCs where the I/O station 1 is reserved for the local I/O, words `word11` to `word13` are allocated as follows:

`word11` shows the global I/O station status:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Bit	Allocation
1	All modules OK
9 - 16	Counts, how often a module is regarded as not OK, counter overflow is at 255

`word12` is used as a 16 bit I/O bus error counter.
`word13` is used as a 16 bit I/O repetition counter.

SET_TOD: Setting the hardware clock (Time Of Day)

15

Description

Function description

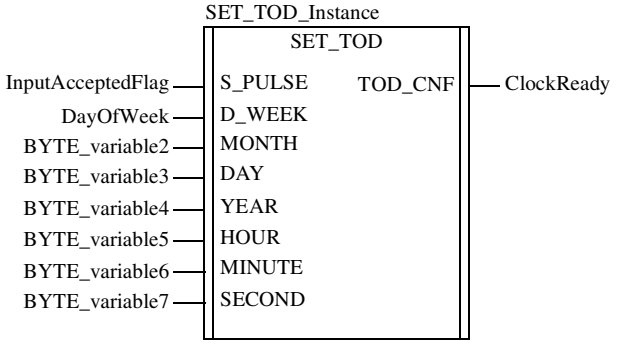
This function block searches (together with the other function blocks in the HSBY group) the configuration of the respective PLC for the necessary components. These components always refer to the hardware actually connected.
Therefore the correct functioning of this function block on the simulators cannot be guaranteed.
The function block sets the hardware system clock, if the corresponding registers are provided within this configuration. If these registers are not present, the `TOD_CNF` output is set to "0".
The function block reads the input values on the `S_PULSE` input at a rising edge and transfers them to the hardware clock.
For all input values:

- If the value exceeds the specified maximum value, the maximum is used.
- If the value falls below the specified minimum value, the minimum is used.

`EN` and `ENO` can be configured as additional parameters.

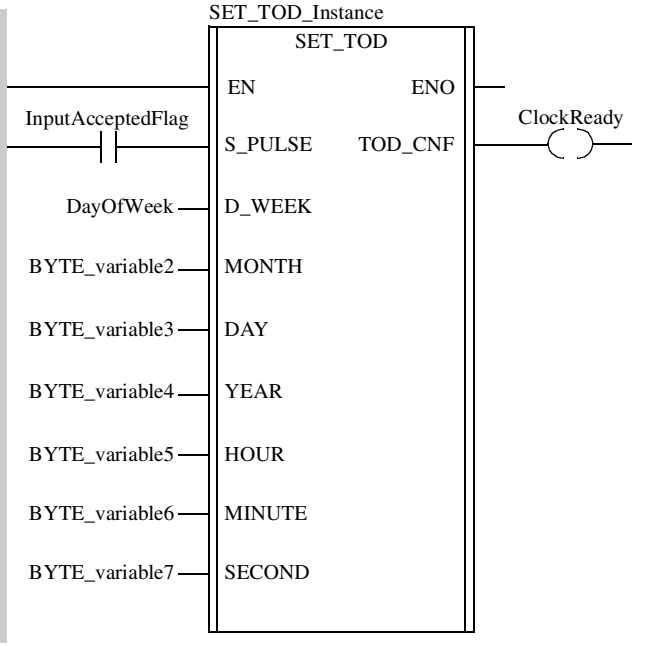
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL SET_TOD_Instance (S_PULSE:=InputAcceptedFlag,
    D_WEEK:=DayOfWeek, MONTH:=Byte_variable2,
    DAY:=Byte_variable3, YEAR:=Byte_variable4,
    HOUR:=Byte_variable5, MINUTE:=Byte_variable6,
    SECOND:=Byte_variable7, TOD_CNF=>ClockReady)
```

Representation in ST

Representation:

```
SET_TOD_Instance (S_PULSE:=InputAcceptedFlag,
    D_WEEK:=DayOfWeek, MONTH:=Byte_variable2,
    DAY:=Byte_variable3, YEAR:=Byte_variable4,
    HOUR:=Byte_variable5, MINUTE:=Byte_variable6,
    SECOND:=Byte_variable7, TOD_CNF=>ClockReady) ;
```

Parameter description

Description of the input parameters:

Parameters	Data type	Meaning
S_PULSE	BOOL	"0 -> 1" = the input values are accepted and written into the clock.
D_WEEK	BYTE	Day of week, 1 = Sunday 7 = Saturday
MONTH	BYTE	Month 1..12
DAY	BYTE	Day 1..31
YEAR	BYTE	Year 0..99
HOUR	BYTE	Hour 0..23
MINUTE	BYTE	Minute 0..59
SECOND	BYTE	Second 0..59

Description of the output parameters:

Parameters	Data type	Meaning
TOD_CNF	BOOL	"1" = %MW register (4x) for the hardware system clock was found and the clock is operational. "0" = Time is currently being set or hardware clock was not found.

GET_TOD: Reading the hardware clock (Time Of Day)

16

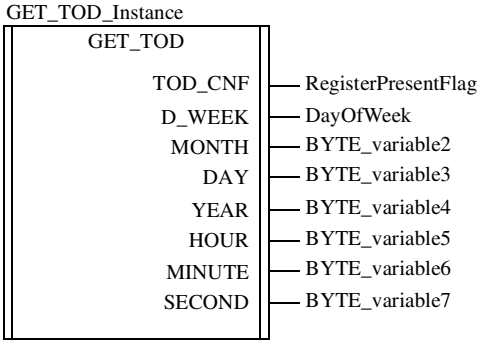
Description

Function description

This function block searches (together with the other function blocks in the HSBY group) the configuration of the respective PLC for the necessary components. These components always refer to the hardware actually connected.
Therefore the correct functioning of this function block on the simulators cannot be guaranteed.
The `GET_TOD` function block reads the hardware clock, if relevant registers are provided with this configuration. If these registers are not present, the `TOD_CNF` output is set to "0".
`EN` and `ENO` can be configured as additional parameters.

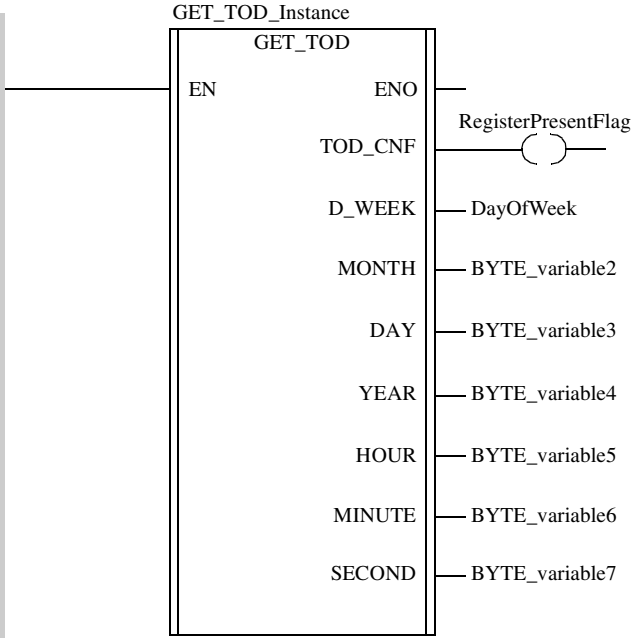
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL GET_TOD_Instance (TOD_CNF=>RegisterPresentFlag,
    D_WEEK=>DayOfWeek, MONTH=>Byte_variable2,
    DAY=>Byte_variable3, YEAR=>Byte_variable4,
    HOUR=>Byte_variable5, MINUTE=>Byte_variable6,
    SECOND=>Byte_variable7)
```

Representation in ST

Representation:

```
GET_TOD_Instance (TOD_CNF=>RegisterPresentFlag,
    D_WEEK=>DayOfWeek, MONTH=>Byte_variable2,
    DAY=>Byte_variable3, YEAR=>Byte_variable4,
    HOUR=>Byte_variable5, MINUTE=>Byte_variable6,
    SECOND=>Byte_variable7) ;
```

Parameter description

Description of the output parameters:

Parameters	Data type	Meaning
TOD_CNF	BOOL	"1" = 4x-register for hardware system clock was found and the clock is operational. "0" = time is set at the moment. In this case the other outputs keep their values.
D_WEEK	BYTE	Weekday, 1 = Sunday .. 7 = Saturday
MONTH	BYTE	Month 1..12
DAY	BYTE	Day 1..31
YEAR	BYTE	Year 0..99
HOUR	BYTE	Hour 0..23
MINUTE	BYTE	Minute 0..59
SECOND	BYTE	Second 0..59

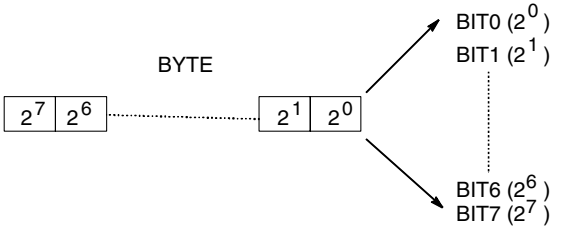
BYTE_TO_BIT_DFB: Type conversion

17

Description

Function description

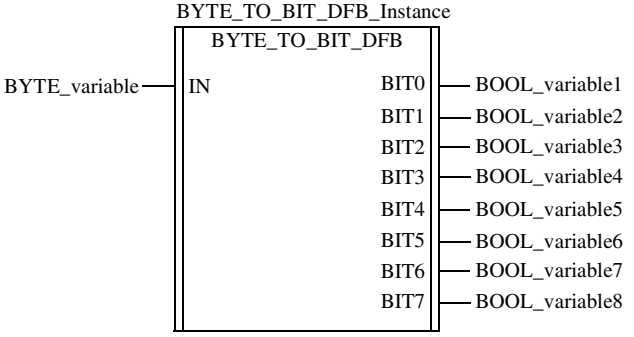
This derived function block converts one input word from the BYTE data type to 8 output values of the BOOL data type.
The individual bits of the byte at the input are assigned to the outputs according to the output names.



EN and ENO can be configured as additional parameters.

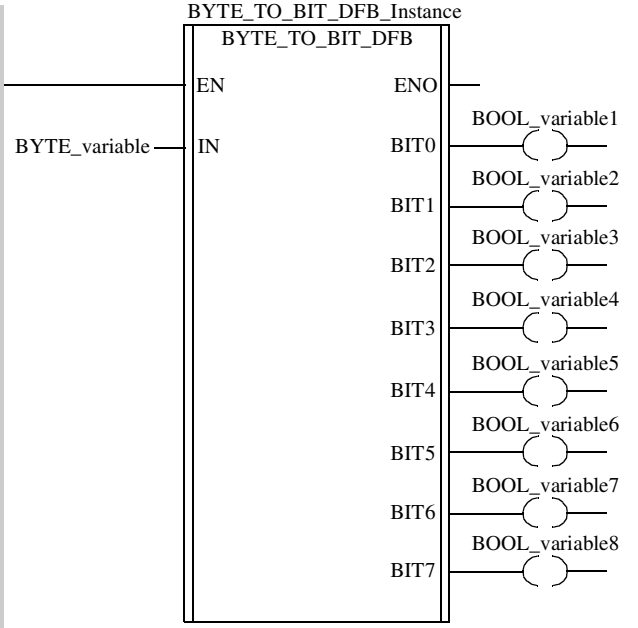
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL BYTE_TO_BIT_DFB_Instance (IN:=BYTE_variable,
    BIT0=>BOOL_variable1, BIT1=>BOOL_variable2,
    BIT2=>BOOL_variable3, BIT3=>BOOL_variable4,
    BIT4=>BOOL_variable5, BIT5=>BOOL_variable6,
    BIT6=>BOOL_variable7, BIT7=>BOOL_variable8)
```

Representation in ST

Representation:

```
BYTE_TO_BIT_DFB_Instance (IN:=BYTE_variable,
    BIT0=>BOOL_variable1, BIT1=>BOOL_variable2,
    BIT2=>BOOL_variable3, BIT3=>BOOL_variable4,
    BIT4=>BOOL_variable5, BIT5=>BOOL_variable6,
    BIT6=>BOOL_variable7, BIT7=>BOOL_variable8) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
IN	BYTE	Input

Description of the output parameters:

Parameter	Data type	Meaning
BIT0	BOOL	Output bit 0
BIT1	BOOL	Output bit 1
:	:	:
BIT7	BOOL	Output bit 7

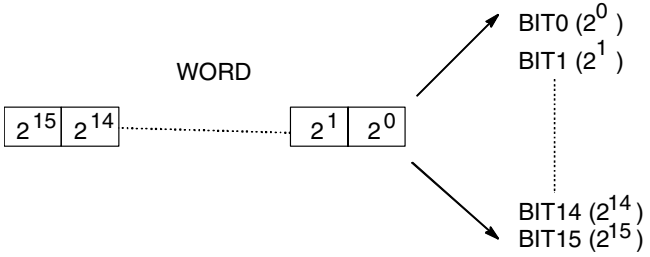
WORD_TO_BIT_DFB: Type conversion

18

Description

Function description

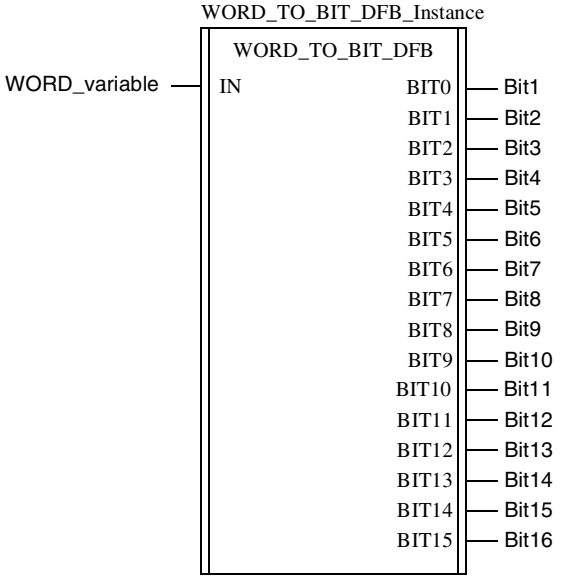
This derived function block converts one input word from the `WORD` data type to 16 output values of the `BOOL` data type.
The individual bits of the word at the input are assigned to the outputs according to the output names.



`EN` and `ENO` can be configured as additional parameters.

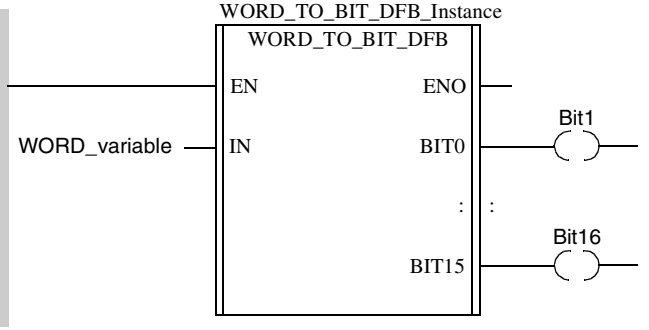
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL WORD_TO_BIT_DFB_Instance (IN:=WORD_variable,
    BIT0=>Bit1, BIT1=>Bit2, BIT2=>Bit3, BIT3=>Bit4,
    BIT4=>Bit5, BIT5=>Bit6, BIT6=>Bit7, BIT7=>Bit8,
    BIT8=>Bit9, BIT9=>Bit10, BIT10=>Bit11, BIT11=>Bit12,
    BIT12=>Bit13, BIT13=>Bit14, BIT14=>Bit15, BIT15=>Bit16)
```

Representation in ST

Representation:

```
WORD_TO_BIT_DFB_Instance (IN:=WORD_variable,
    BIT0=>Bit1, BIT1=>Bit2, BIT2=>Bit3, BIT3=>Bit4,
    BIT4=>Bit5, BIT5=>Bit6, BIT6=>Bit7, BIT7=>Bit8,
    BIT8=>Bit9, BIT9=>Bit10, BIT10=>Bit11, BIT11=>Bit12,
    BIT12=>Bit13, BIT13=>Bit14, BIT14=>Bit15,
    BIT15=>Bit16) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
IN	WORD	Input

Description of the output parameters:

Parameter	Data type	Meaning
BIT0	BOOL	Output BIT0
BIT1	BOOL	Output BIT1
:	:	:
BIT15	BOOL	Output BIT15

WORD_AS_BYTE_DFB: Type conversion

19

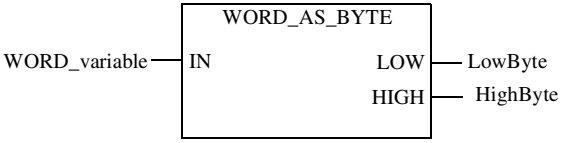
Description

Function description

This derived function block converts one input word from the WORD data type to 2 output values of the BYTE data type.
The individual bytes of the word at the input are assigned to the outputs according to the output names.
EN and ENO can be configured as additional parameters.

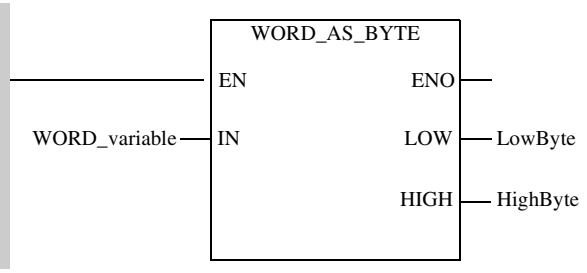
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL WORD_AS_BYTE_DFB_Instance (IN:=WORD_variable,
    LOW=>LowByte, HIGH=>HighByte)
```

Representation in ST

Representation:

```
WORD_AS_BYTE_DFB_Instance (IN:=WORD_variable,
    LOW=>LowByte, HIGH=>HighByte) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
IN	WORD	Input

Description of the output parameters:

Parameter	Data type	Meaning
LOW	BYTE	least significant byte
HIGH	BYTE	most significant byte

DINT_AS_WORD_DFB: Type conversion

20

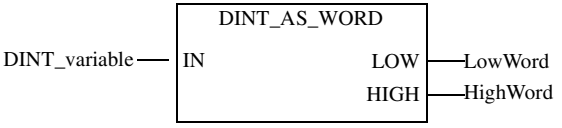
Description

Function description

This derived function block converts one input word from the DINT data type to 2 output values of the WORD data type.
The individual words of the DINT input are assigned to the outputs according to the output names.
EN and ENO can be configured as additional parameters.

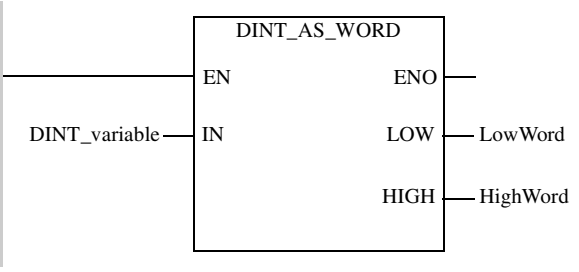
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL DINT_AS_WORD_DFB_Instance (IN:=DINT_variable,
    LOW=>LowWord, HIGH=>HighWord)
```

Representation in ST

Representation:

```
DINT_AS_WORD_DFB_Instance (IN:=DINT_variable,
    LOW=>LowWord, HIGH=>HighWord) ;
```

Parameter description

Description of the input parameters:

Parameters	Data type	Meaning
IN	DINT	Input

Description of the output parameters:

Parameters	Data type	Meaning
LOW	WORD	least significant word
HIGH	WORD	most significant word

LIMIT_IND_DFB: Limit with indicator

21

Description

Function description

This derived function block transfers the unchanged input value (`Input`) to the `Output`, if the input value is not less than the minimum value (`LimitMinimum`) and does not exceed the maximum value (`LimitMaximum`). If the input value (`Input`) is less than the minimum value (`LimitMinimum`), the minimum value will be transferred to the output. If the input value (`Input`) exceeds the maximum value (`LimitMaximum`), the maximum value will be transferred to the output.
Additionally, a indication is given if the minimum or maximum value is violated. If the value at the (`Input`) input is less than the value at the (`LimitMinimum`) input, the (`MinimumViolation`) output becomes "1". If the value at the (`Input`) input is more than the value at the (`LimitMaximum`) input, the (`MaximumViolation`) output becomes "1".
The data types of the (`LimitMinimum`, `Input`, `LimitMaximum`) input values and the (`Output`) output value must be identical.
`EN` and `ENO` can be configured as additional parameters.

Formula

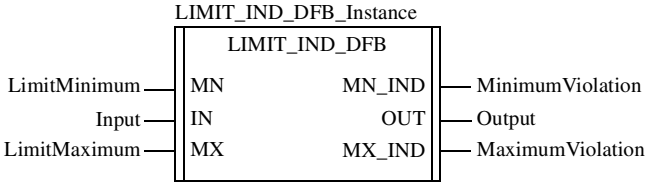
Block formula:
`OUT` = `IN`, if (`IN` ≤ `MX`) & `IN` ≥ `MN`
`OUT` = `MN`, if (`IN` < `MN`)
`OUT` = `MX`, if (`IN` > `MX`)

`MN_IND` = 0, if `IN` ≥ `MN`
`MN_IND` = 1, if `IN` < `MN`

`MX_IND` = 0, if `IN` ≤ `MX`
`MX_IND` = 1, if `IN` > `MX`

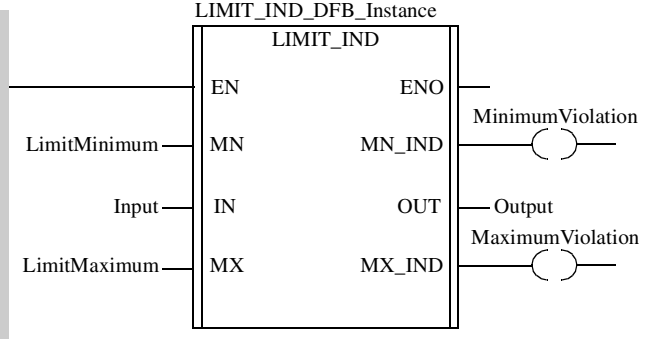
Representation in FBD

Representation:



Representation in LD

Representation:



Representation in IL

Representation:

```
CAL LIMIT_IND_DFB (MN:=LimitMinimum, IN:=INPUT,
    MX:=LimitMaximum, MN_IND=>MinimumViolation,
    OUT=>Output, MX_IND=>MaximumViolation)
```

Representation in ST

Representation:

```
LIMIT_IND_DFB (MN:=LimitMinimum, IN:=INPUT,
    MX:=LimitMaximum, MN_IND=>MinimumViolation,
    OUT=>Output, MX_IND=>MaximumViolation) ;
```

Parameter description

Description of the input parameters:

Parameter	Data type	Meaning
LimitMinimum	BOOL, BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, REAL, TIME	Limit of minimum value
Input	BOOL, BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, REAL, TIME	Input
LimitMaximum	BOOL, BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, REAL, TIME	Limit of maximum value

Description of the output parameters:

Parameter	Data type	Meaning
MinimumViolation	BOOL	Display of minimum value violation
Output	BOOL, BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, REAL, TIME	Output
MaximumViolation	BOOL	Display of maximum value violation

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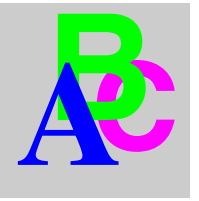

Numerics

A

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